OZONE SEASON SUMMARY 2022

Sunil Kumar
Principal Environmental Engineer

MWAQC-TAC
September 13, 2022

Agenda Item 2

Metropolitan Washington
Council of Governments

Peak 8-Hour Average Ozone Levels (ppb)

March 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	01	02	03	04	05
		47	47	46	44	48
06	07	08	09	10	11	12
43	38	46	43	43	47	46
13	14	15	16	17	18	19
44	52	57	58	43	52	44
20	21	22	23	24	25	26
42	53	55	43	26	47	42
27	28	29	30	31		
39	44	46	51	46		

April 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	31	01	02
					42	49
03	04	05	06	07	08	09
47	48	39	41	39	49	39
10	11	12	13	14	15	16
42	46	51	57	46	59	57
17	18	19	20	21	22	23
44	32	39	48	50	61	60
24	25	26	27	28	29	30
64	47	39	47	46	57	56

May 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
01	02	03	04	05	06	07
						45
08	09	10	11	12	13	14
49	62	63	53	39	24	29
15	16	17	18	19	20	21
43	48	60	47	54	63	62
22	23	24	25	26	27	28
55	45	36	40	30	34	41
29	30	31				
55	56	66				

June 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30	31	01	02	03	04
			59	54	51	66
05	06	07	08	09	10	11
58	60	48	63	55	53	37
12	13	14	15	16	17	18
47	65	47	77	54	61	41
19	20	21	22	23	24	25
45	59	65	72	45	66	54
26	27	28	29	30		
49	47	56	60	76		

July 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
26	27	28	29	30	01	02
					55	50
03	04	05	06	07	08	09
54	60	41	57	58	55	40
10	11	12	13	14	15	16
52	69	49	63	59	65	54
17	18	19	20	21	22	23
43	38	60	66	56	62	68
24	25	26	27	28	29	30
61	46	36	55	49	49	51

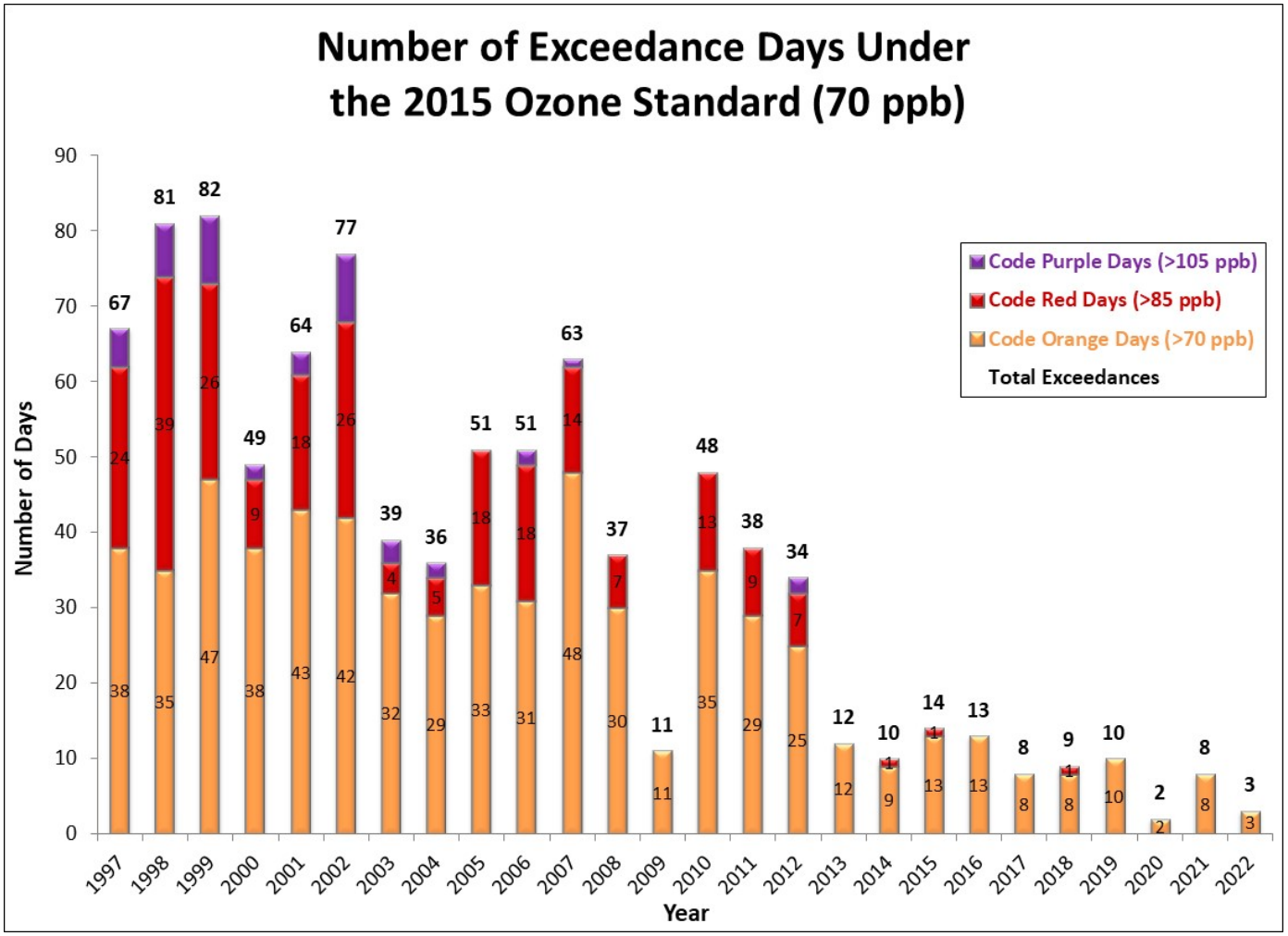
August 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
31	01	02	03	04	05	06
	49	54	63	68	60	40
07	08	09	10	11	12	13
32	42	48	53	56	44	48
14	15	16	17	18	19	20
50	40	55	54	58	52	55
21	22	23	24	25	26	27
34	41	51	56	57	57	59
28	29	30	31			
57	52	47	47			

3 Code Orange days, 62 Code Yellow Days, rest all Code Green Days

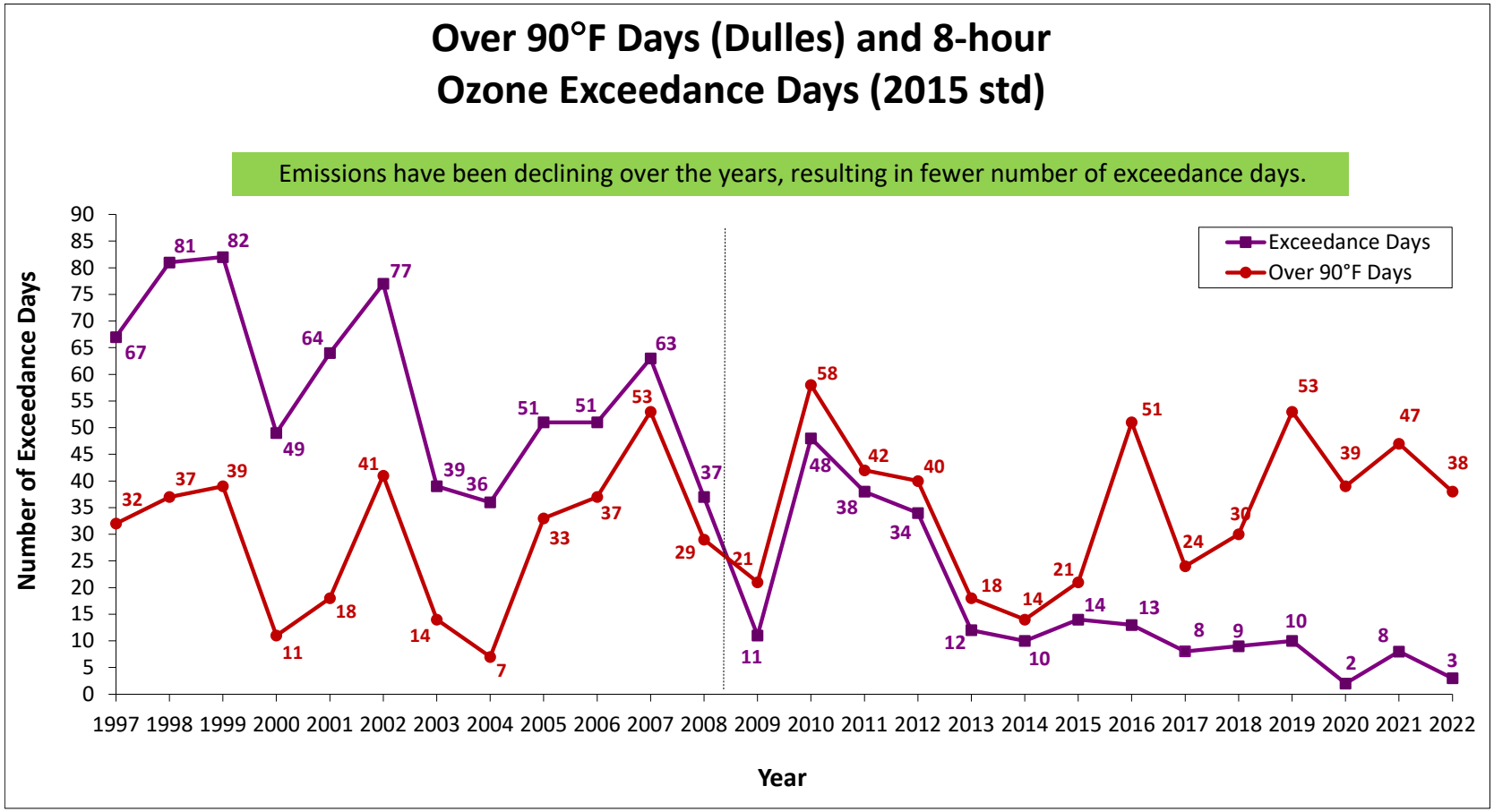
Analysis is based on draft data as of September 1, 2022.

Ozone Exceedance Trend



2022 data is draft and incomplete as of September 1, 2022.

Ozone & Temperature Trend



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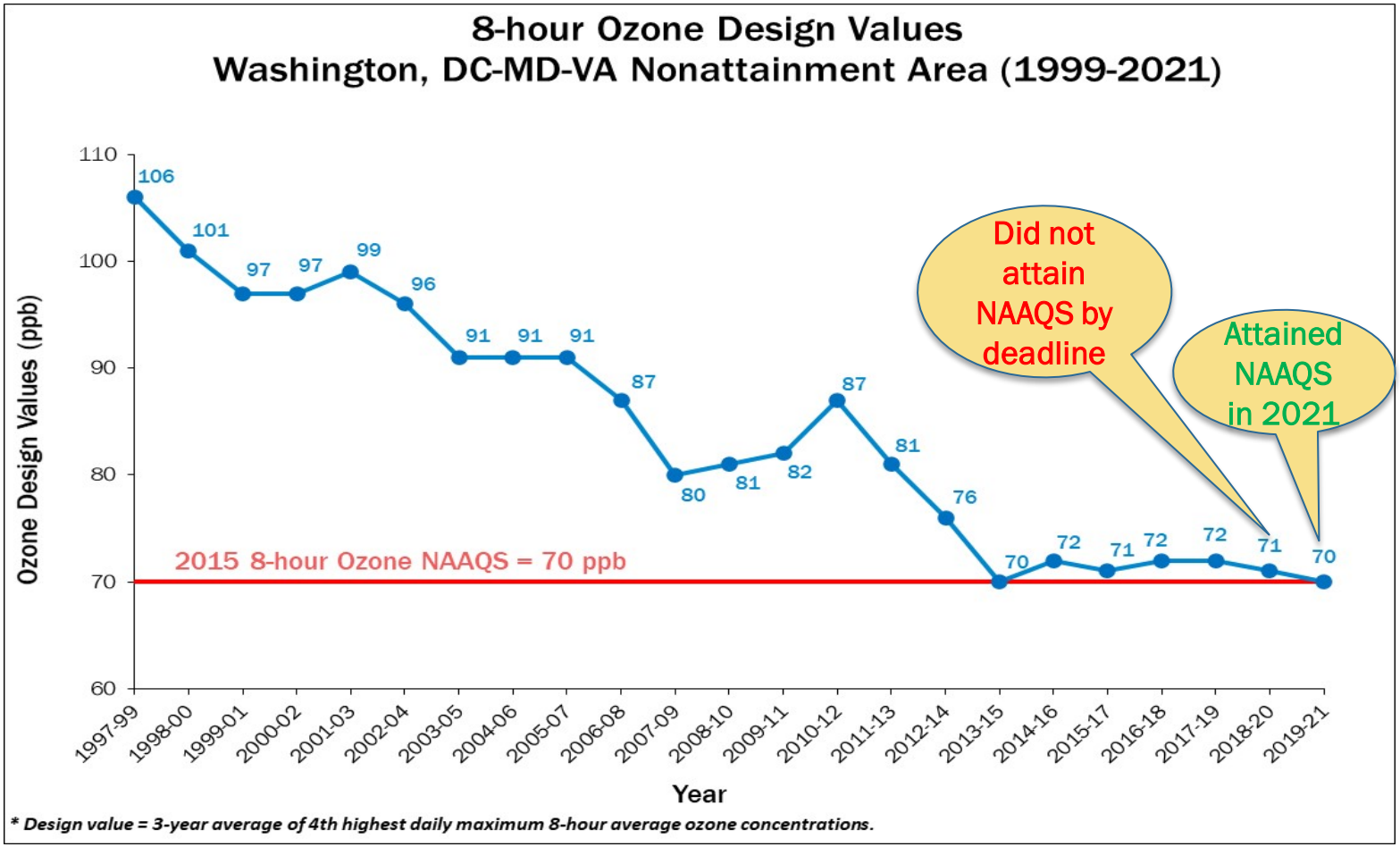
Ozone Design Value Trend

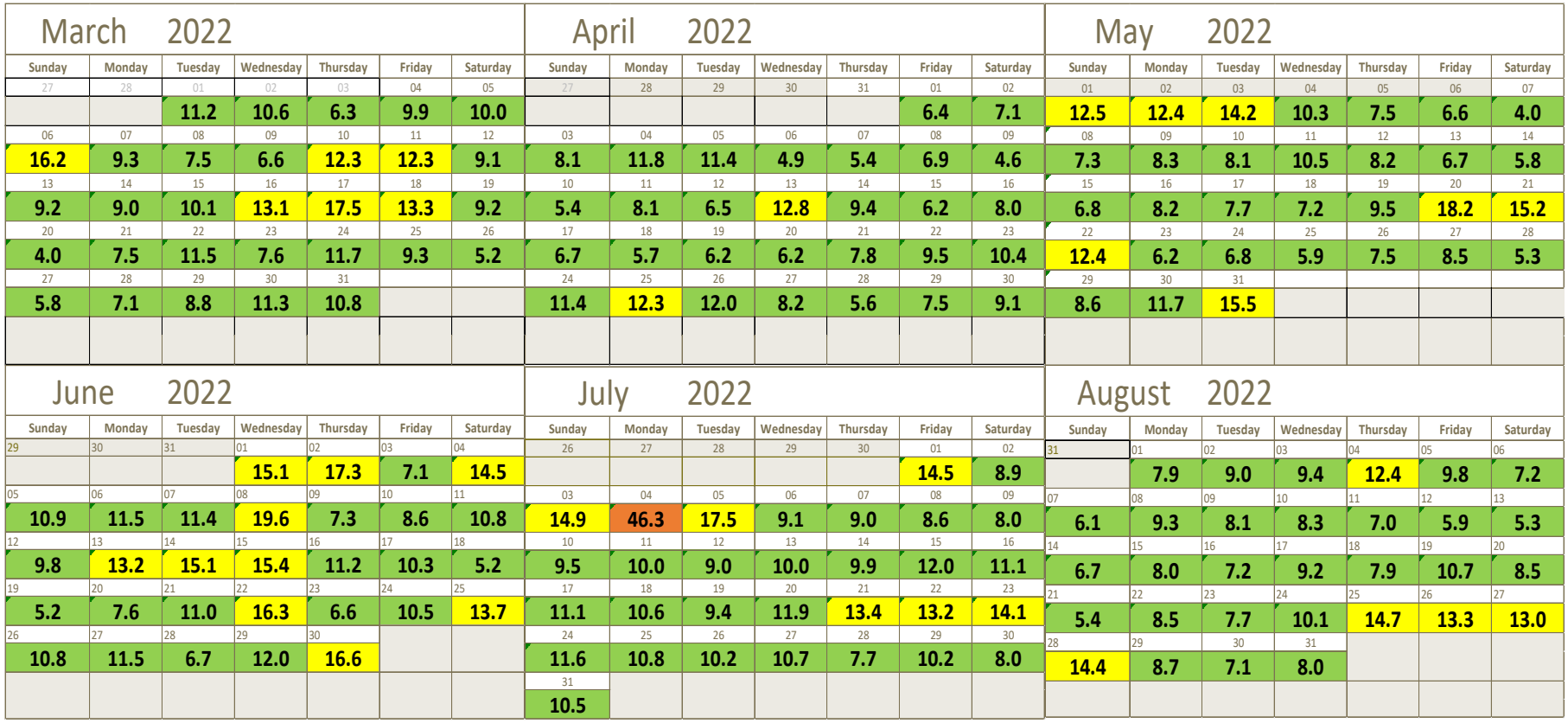


Why Fewer Exceedance Days Now ?

Emission Control Programs

Federal	State	Local
Acid Rain Program (1996/2000)	Vehicle Inspection & Maintenance Programs	Renewable Energy Programs Regional Wind Power Purchase Program Clean Energy Rewards Program Renewable Portfolio Standards
Tier 2 (LD Vehicle) Rule (2004)	Maryland Healthy Air Act (2009/2012)	Energy Efficiency Programs LED Traffic Signal Retrofit program Building Energy Efficiency Programs
HD Diesel vehicle Rule (2004/2007)	Virginia CSAPR Rule	VRE Idling Reduction
NOX SIP Call (2004)	Ozone Transport Commission Rules	LOW VOC Paint
CAIR/CSAPR/CSAPR Update/Revised CSAPR Update (2009/2015/2017/2021)		Gas Can Replacement

24-Hour Average PM2.5 Levels (µg/m³)



March 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	01	02	03	04	05
		11.2	10.6	6.3	9.9	10.0
06	07	08	09	10	11	12
16.2	9.3	7.5	6.6	12.3	12.3	9.1
13	14	15	16	17	18	19
9.2	9.0	10.1	13.1	17.5	13.3	9.2
20	21	22	23	24	25	26
4.0	7.5	11.5	7.6	11.7	9.3	5.2
27	28	29	30	31		
5.8	7.1	8.8	11.3	10.8		

April 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	31	01	02
					6.4	7.1
03	04	05	06	07	08	09
8.1	11.8	11.4	4.9	5.4	6.9	4.6
10	11	12	13	14	15	16
5.4	8.1	6.5	12.8	9.4	6.2	8.0
17	18	19	20	21	22	23
6.7	5.7	6.2	6.2	7.8	9.5	10.4
24	25	26	27	28	29	30
11.4	12.3	12.0	8.2	5.6	7.5	9.1

May 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
01	02	03	04	05	06	07
12.5	12.4	14.2	10.3	7.5	6.6	4.0
08	09	10	11	12	13	14
7.3	8.3	8.1	10.5	8.2	6.7	5.8
15	16	17	18	19	20	21
6.8	8.2	7.7	7.2	9.5	18.2	15.2
22	23	24	25	26	27	28
12.4	6.2	6.8	5.9	7.5	8.5	5.3
29	30	31				
8.6	11.7	15.5				

June 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30	31	01	02	03	04
			15.1	17.3	7.1	14.5
05	06	07	08	09	10	11
10.9	11.5	11.4	19.6	7.3	8.6	10.8
12	13	14	15	16	17	18
9.8	13.2	15.1	15.4	11.2	10.3	5.2
19	20	21	22	23	24	25
5.2	7.6	11.0	16.3	6.6	10.5	13.7
26	27	28	29	30		
10.8	11.5	6.7	12.0	16.6		

July 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
26	27	28	29	30	01	02
					14.5	8.9
03	04	05	06	07	08	09
14.9	46.3	17.5	9.1	9.0	8.6	8.0
10	11	12	13	14	15	16
9.5	10.0	9.0	10.0	9.9	12.0	11.1
17	18	19	20	21	22	23
11.1	10.6	9.4	11.9	13.4	13.2	14.1
24	25	26	27	28	29	30
11.6	10.8	10.2	10.7	7.7	10.2	8.0
31						
10.5						

August 2022

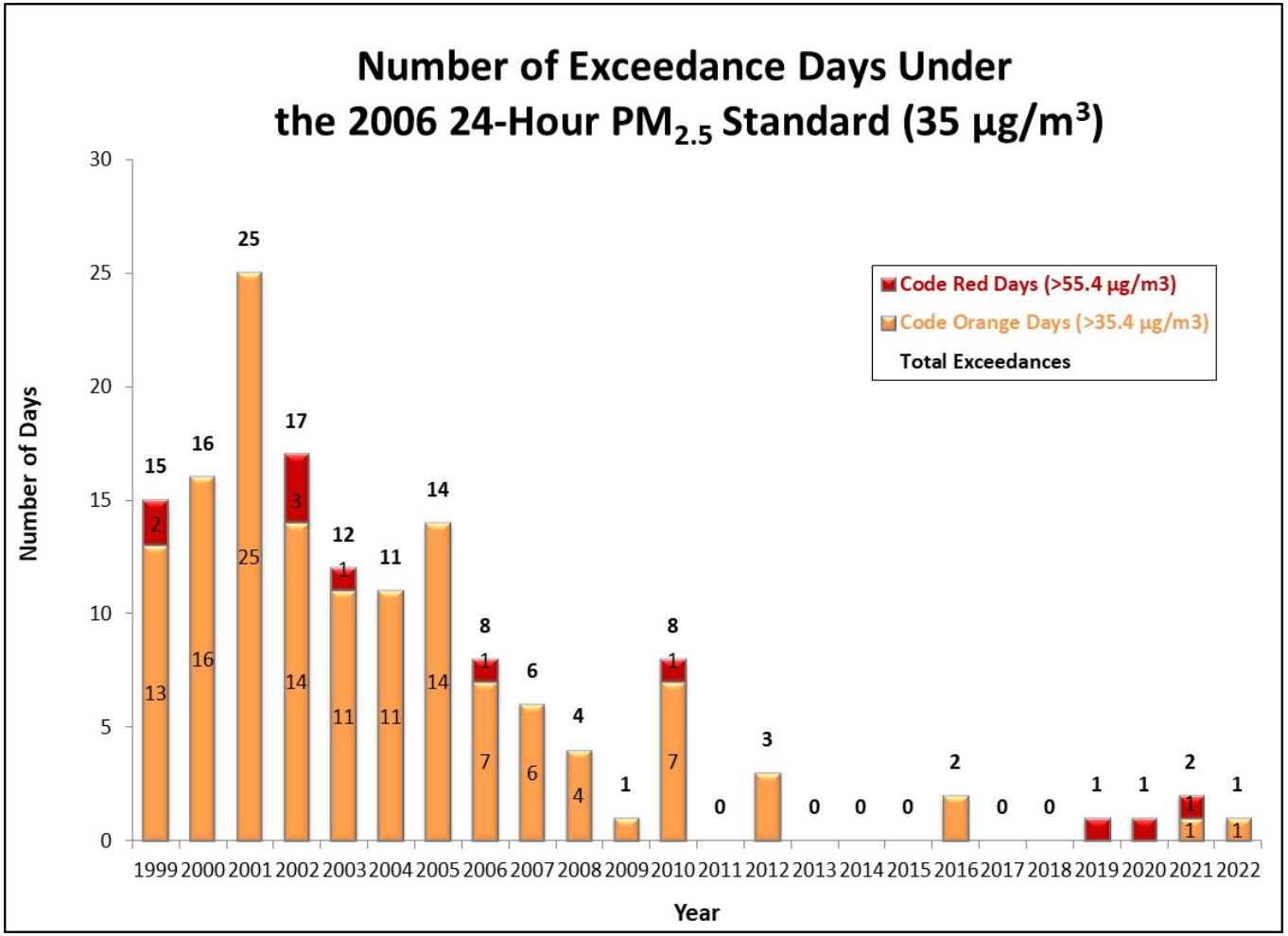
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
31	01	02	03	04	05	06
	7.9	9.0	9.4	12.4	9.8	7.2
07	08	09	10	11	12	13
6.1	9.3	8.1	8.3	7.0	5.9	5.3
14	15	16	17	18	19	20
6.7	8.0	7.2	9.2	7.9	10.7	8.5
21	22	23	24	25	26	27
5.4	8.5	7.7	10.1	14.7	13.3	13.0
28	29	30	31			
14.4	8.7	7.1	8.0			

1 Code Orange Day, 36 Code Yellow Days, rest all Code Green Days

Analysis is based on draft data as of September 1, 2022.

Metropolitan Washington Council of Governments

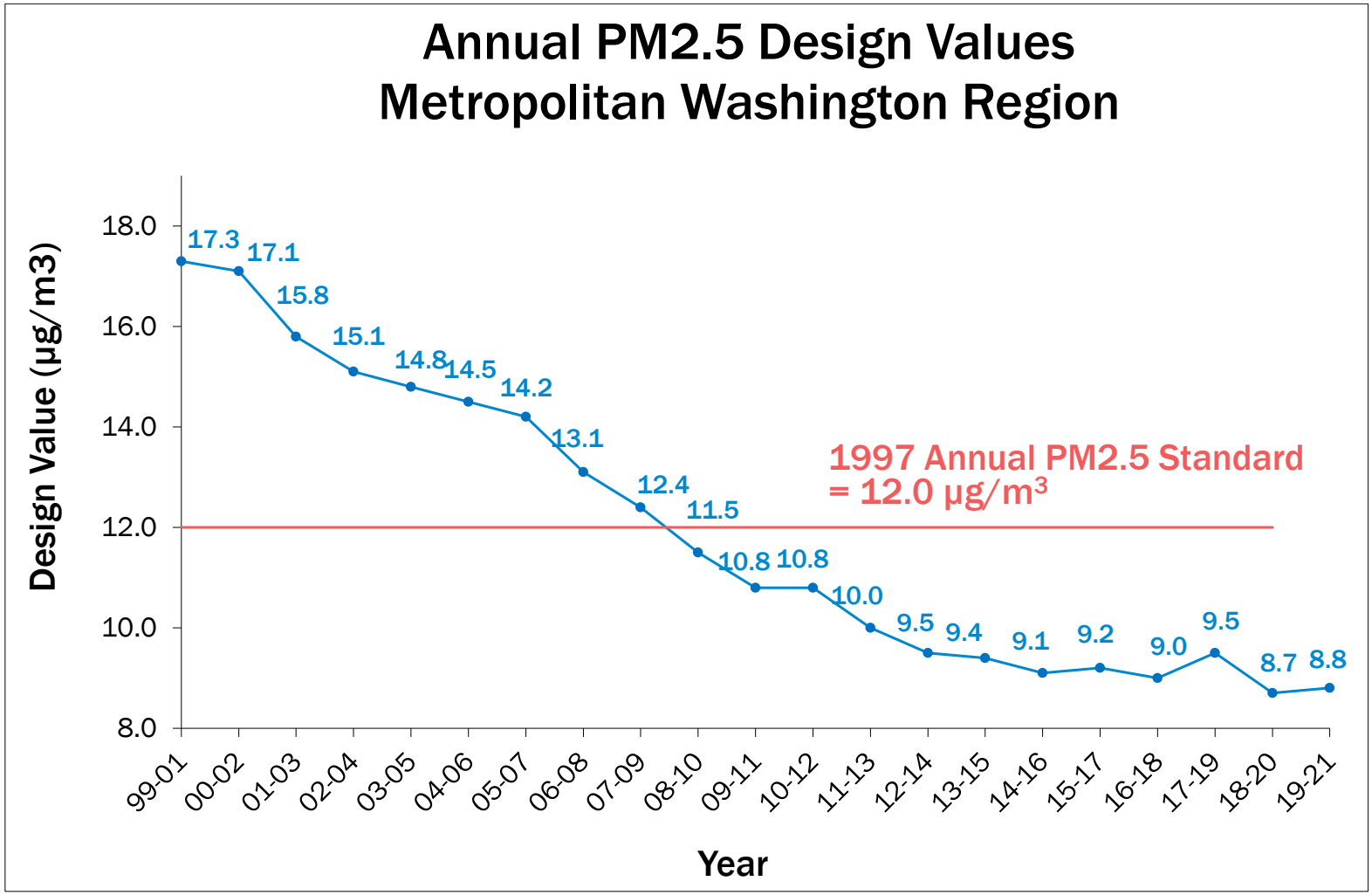
PM2.5 Exceedance Trend



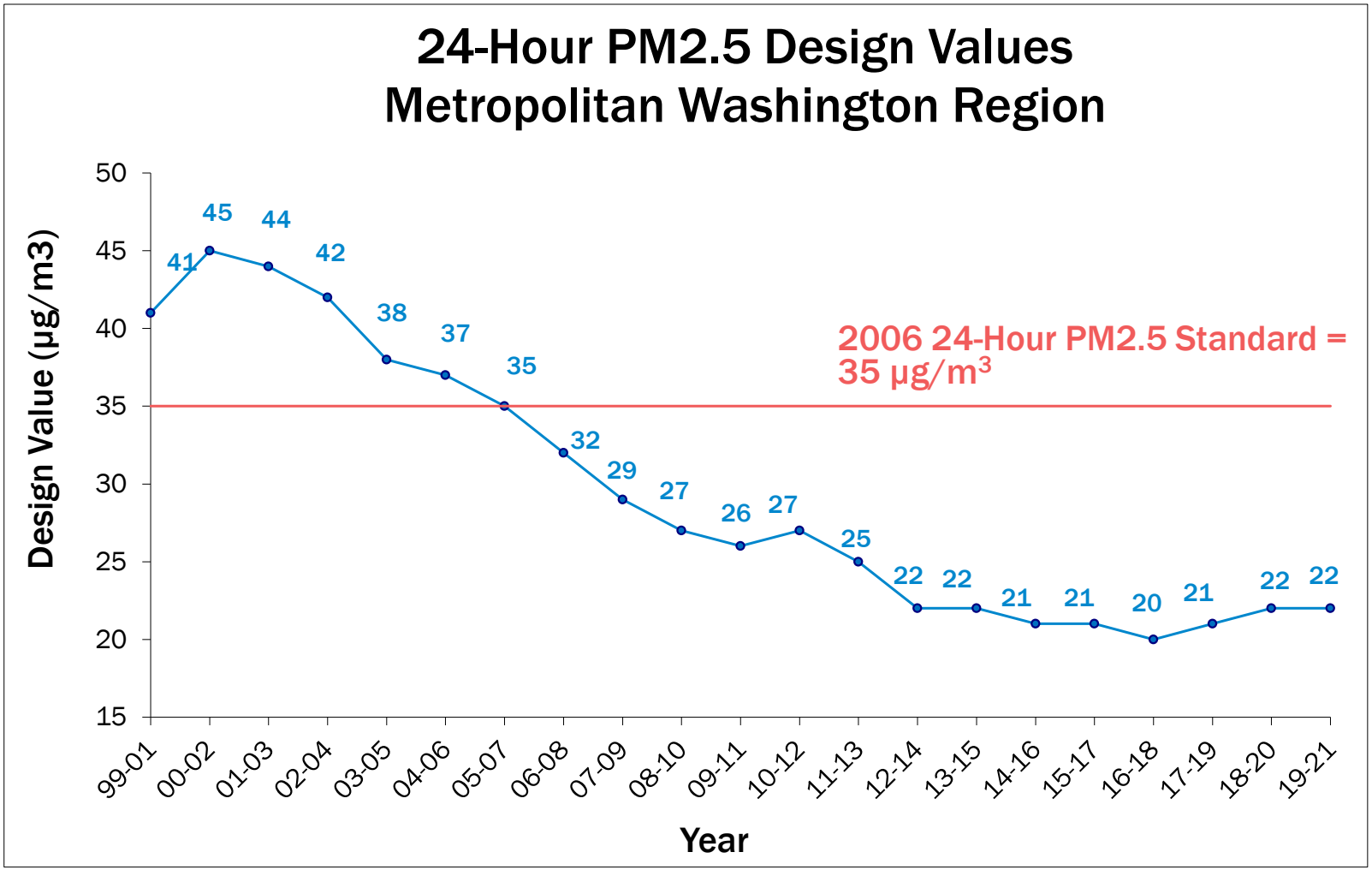
2022 data is draft and incomplete as of September 1, 2022.

Metropolitan Washington
Council of Governments

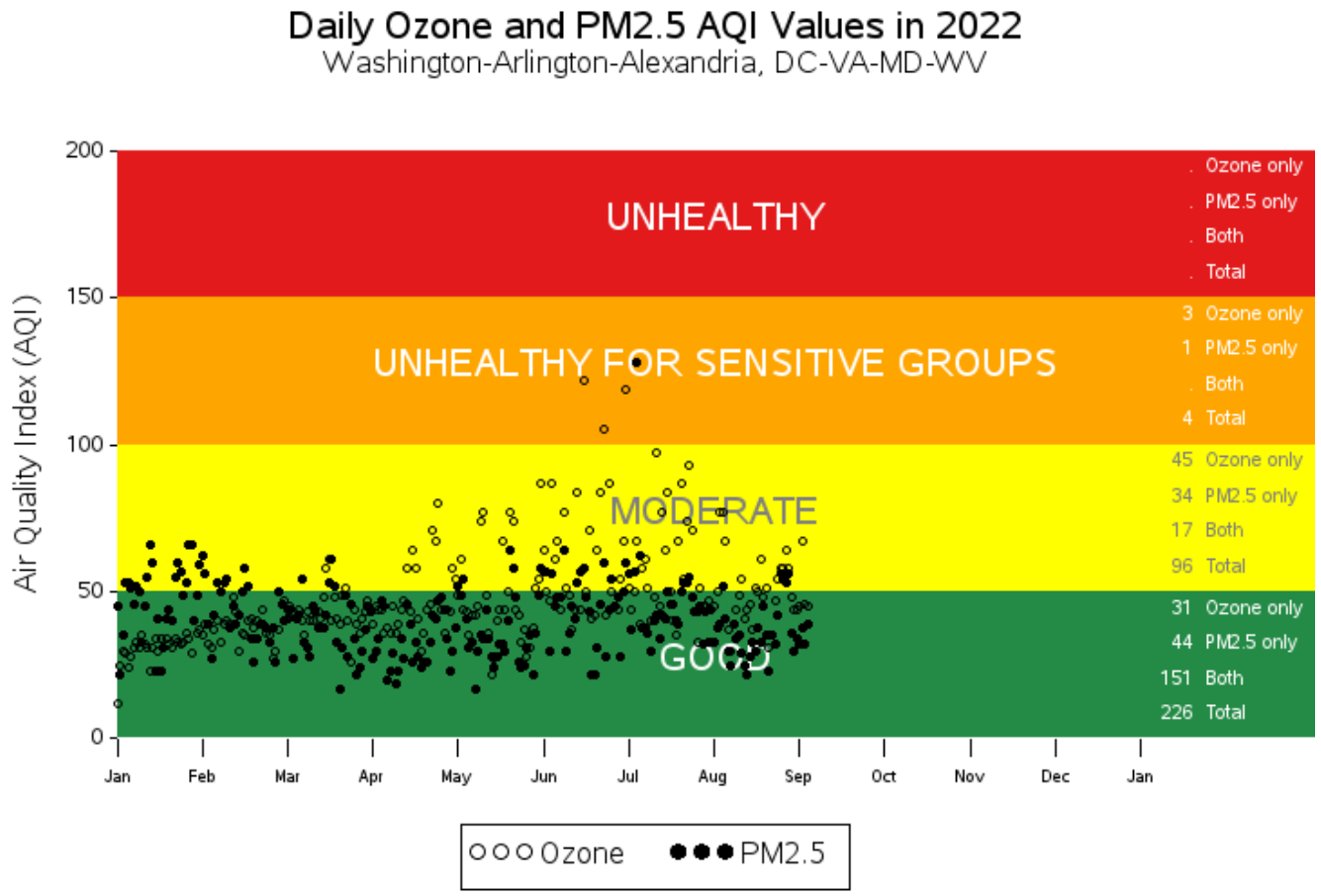
Annual PM2.5 Design Value Trend



24-Hour PM2.5 Design Value Trend

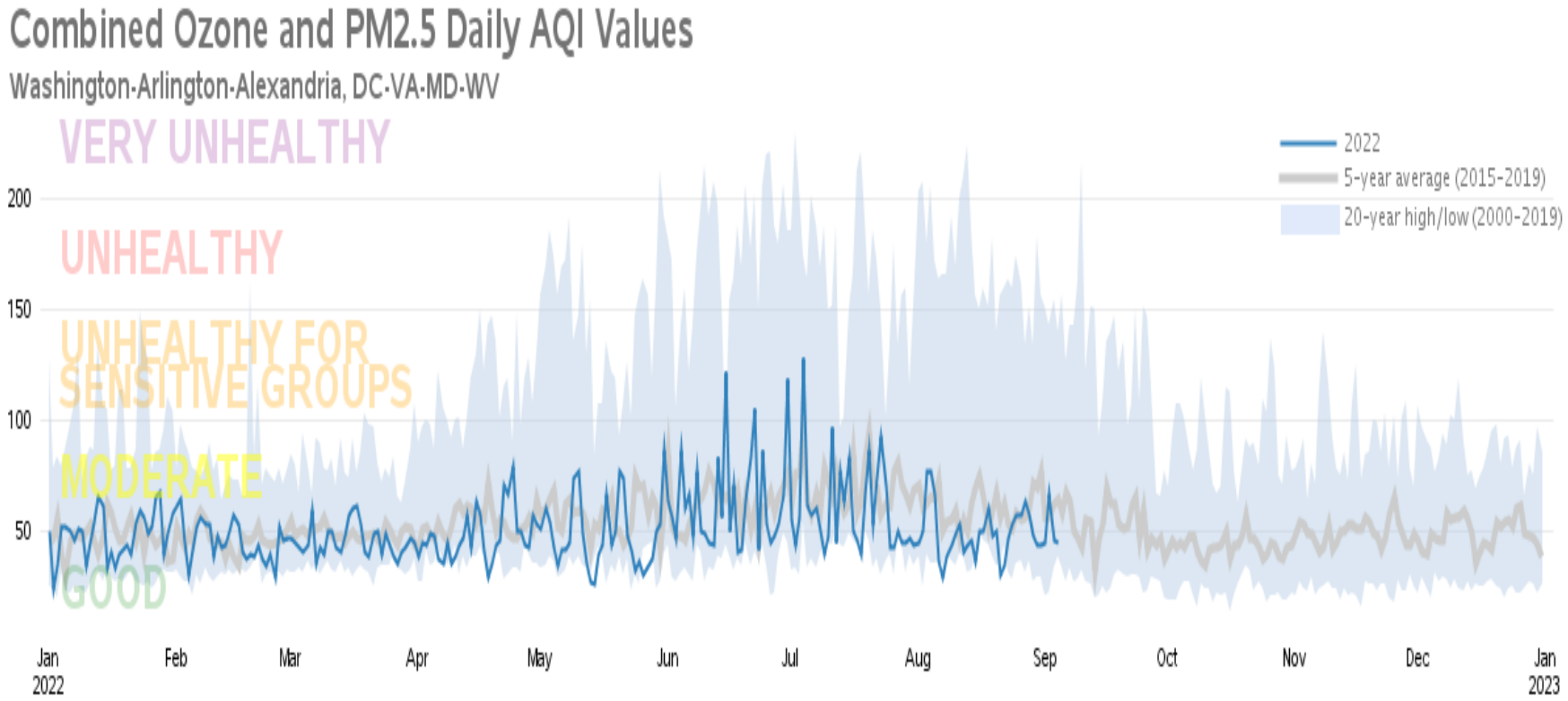


AQI Values - 2022



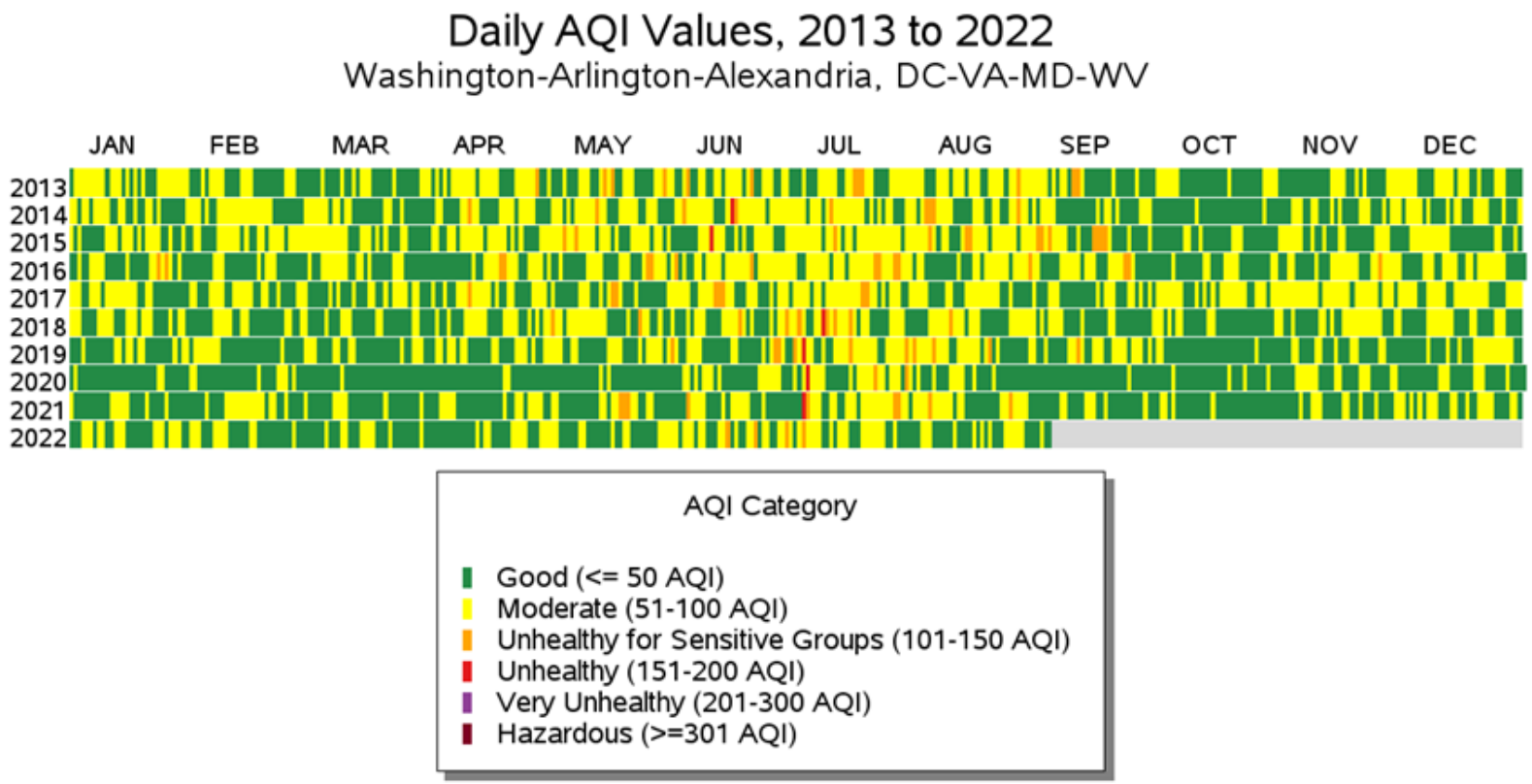
Source: U.S. EPA AirData <https://www.epa.gov/air-data>
Generated: September 5, 2022

AQI Value Trends



Note: Data shown above is for the Washington-Arlington-Alexandria CBSA.

AQI Value Trends



Source: U.S. EPA AirData <https://www.epa.gov/air-data>
Generated: September 5, 2022

Note: Data shown above is for combined AQI values for ozone, PM2.5, PM10, CO, NO2, and SO2 for the Washington-Arlington-Alexandria CBSA.

4th High Ozone Level Needed in 2022 To Violate 2015 Ozone NAAQS

Monitor	4Th High Ozone Needed (ppb)	Observed 4th High Ozone (ppb)*	Draft Design Value (2020-22) (Ppb)	4Th High Ozone Needed in 2023 (ppb)	Highest 4th High Ozone in Last 5 Years
Beltsville (MD)	76	61	67	75	75 (2019)
McMillan (DC)	77	66	67	74	73 (2018)
Fredrick (MD)	83	61	63	85	67 (2018/21)
Rockville (MD)	86	62	63	82	69 (2018)
Loudoun (VA)	87	61	62	86	66 (2021)

* Observed draft data as of September 1, 2022.

Daily 8-Hour Max Ozone Levels (ppb) on Exceedance Days

Site/Site AQS/Param/POC	Date	Date	Date
ASHBURN/511071005/O3/1	06/15/22 61	06/22/22 56	06/30/22 74
AURORA HILLS/510130020/O3/1	06/15/22 65	06/22/22 69	06/30/22 70
Beltsville/240339991/O3/1	06/15/22 58	06/22/22 61	06/30/22 71
Calvert/240090011/O3/1	06/15/22 49	06/22/22 53	06/30/22 48
FRANCONIA/510590030/O3/1	06/15/22 62	06/22/22 59	06/30/22 66
Frederick Airpo/240210037/O3/1	06/15/22 61	06/22/22 54	06/30/22 75
HU-Beltsville/240330030/O3/1	06/15/22 60	06/22/22 57	06/30/22 65
JAMES S. LONG P/511530009/O3/1	06/15/22 52	06/22/22 55	06/30/22 68
McMillan Reserv/110010043/O3/1	06/15/22 77	06/22/22 72	06/30/22 75
PG Equestrian C/240338003/O3/1	06/15/22 51	06/22/22 60	06/30/22 62
RIVER_Terrace/110010041/O3/1	06/15/22 59	06/22/22 60	06/30/22 62
Rockville/240313001/O3/1	06/15/22 67	06/22/22 51	06/30/22 76
Southern Maryla/240170010/O3/1	06/15/22 53	06/22/22 55	06/30/22 54

Exceedance

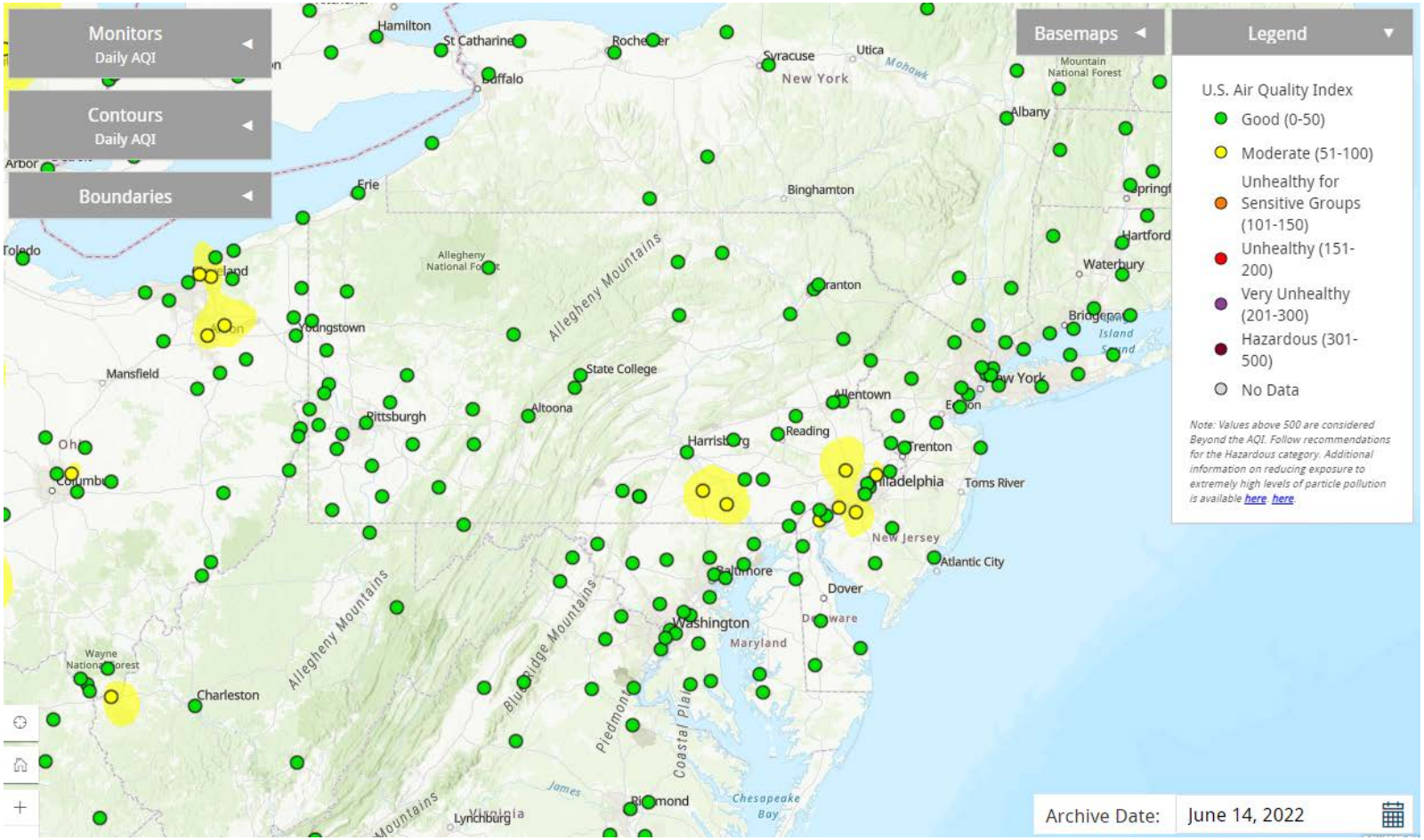
Near Exceedance

* Draft data as of September 1, 2022.

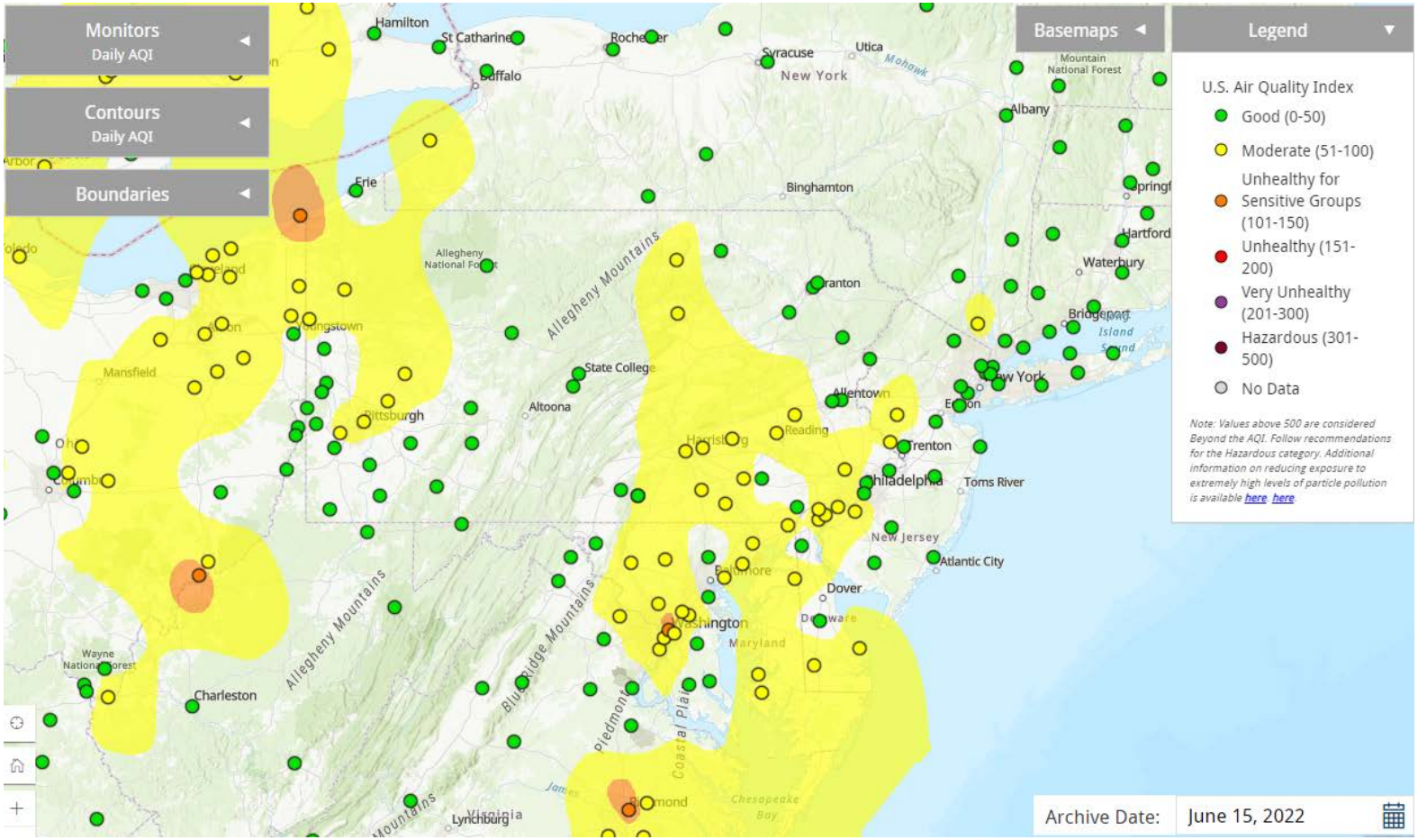
Analysis of 3 Ozone Exceedance Days

- June 15 – Isolated exceedance at McMillan monitor (DC)
- June 22 – Isolated exceedance at McMillan monitor (DC), near exceedance at Arlington (VA)
- June 30 – Wide-spread exceedances at 5 monitors (DC, MD, VA) near exceedance at Arlington (VA)

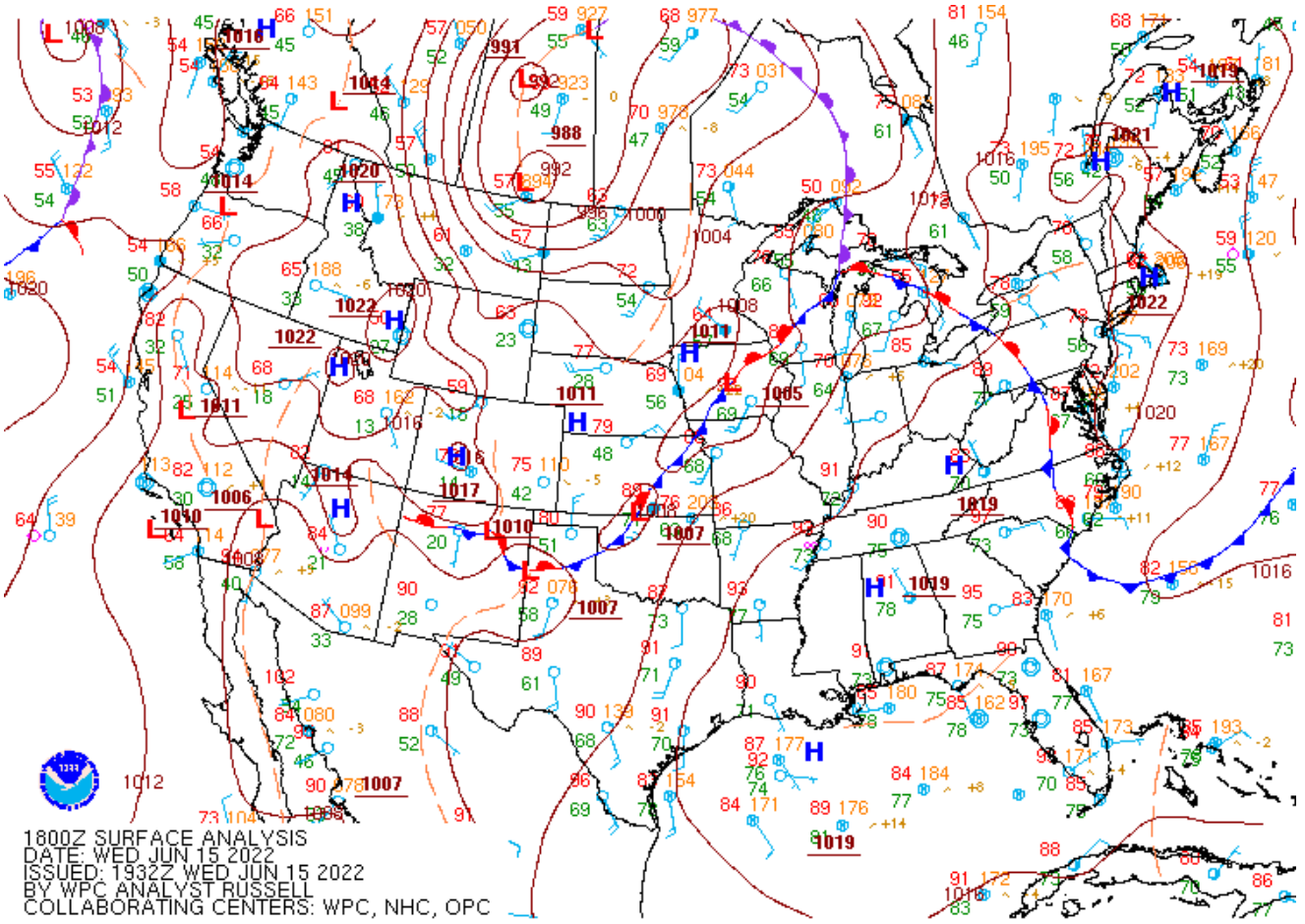
Ozone Levels - 6/14/22



Ozone Levels - 6/15/22



Surface Analysis - June 15

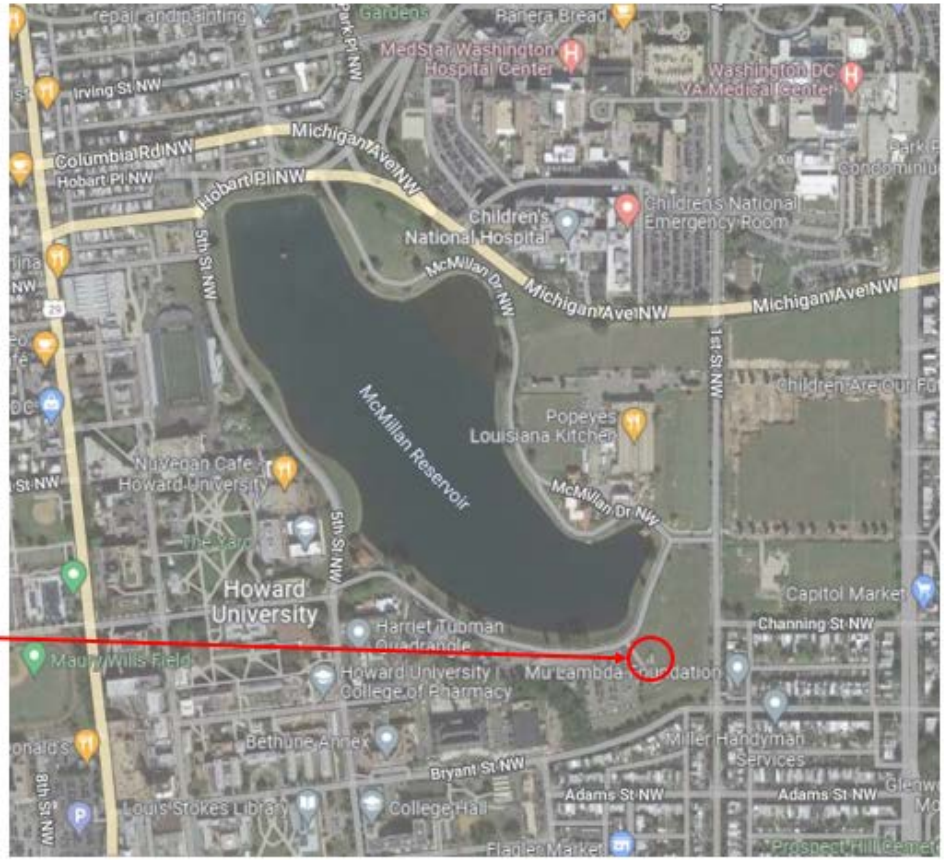


McMillan Monitor Location

McMillan Reservoir

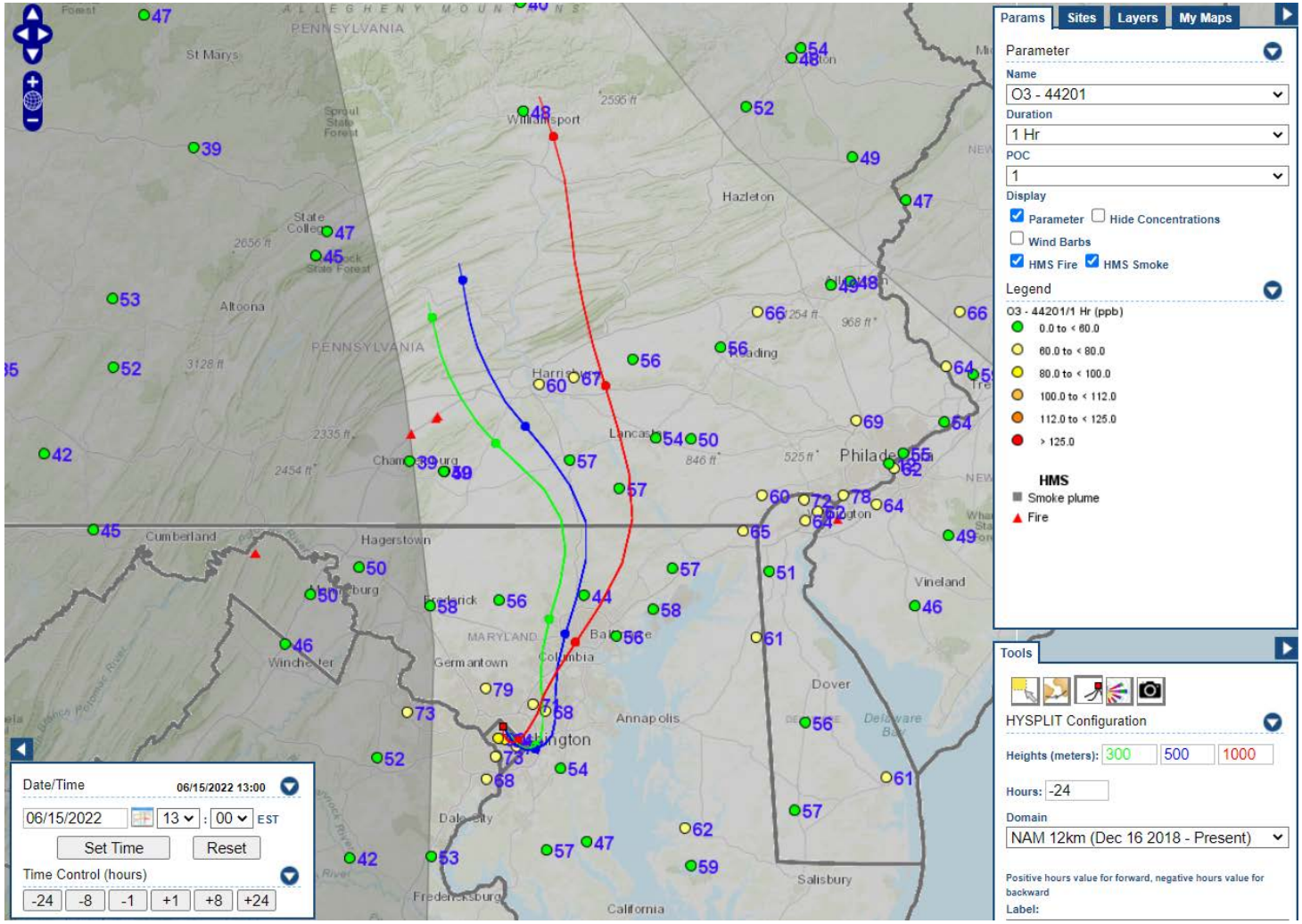
- Reservoir to the NW
- Arterial roads to the N and E
- Hospitals to the N above the arterial
- Construction to the NE
- University to the W
- Residential neighborhoods to S

McMillian, DC
11-001-0043



Source: DOEE

Fire/Smoke - June 15



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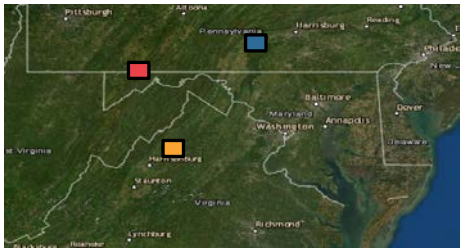
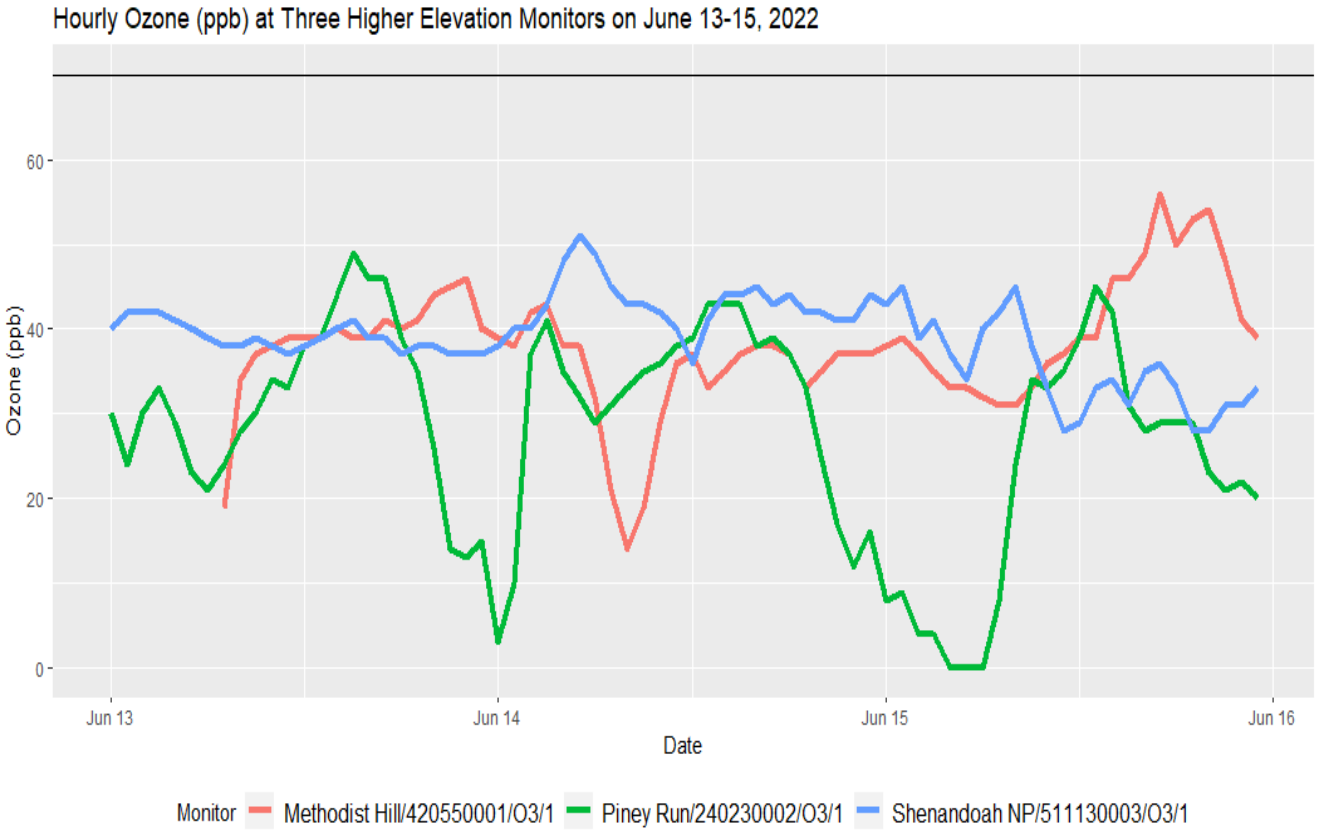
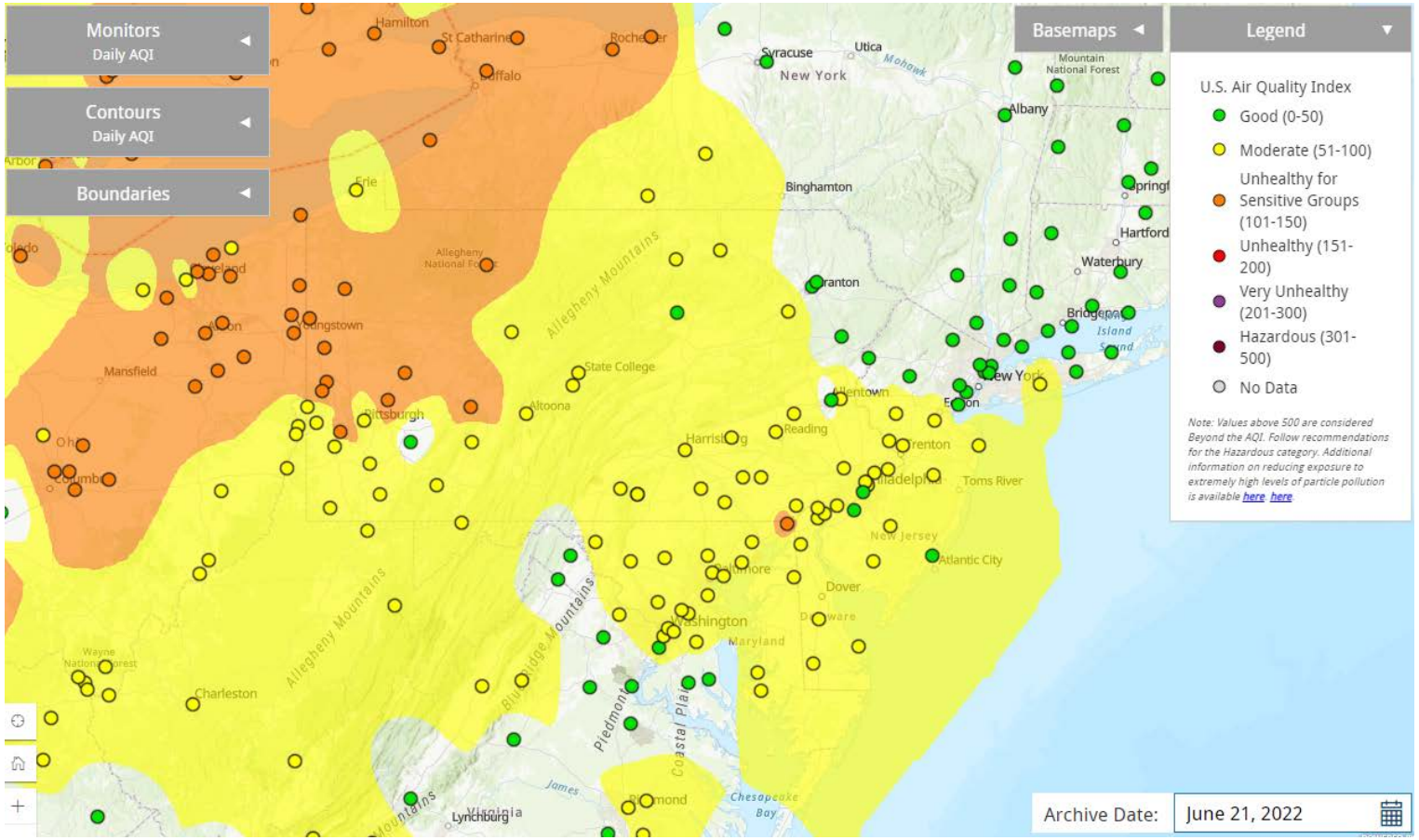
June 15 Transport Signals



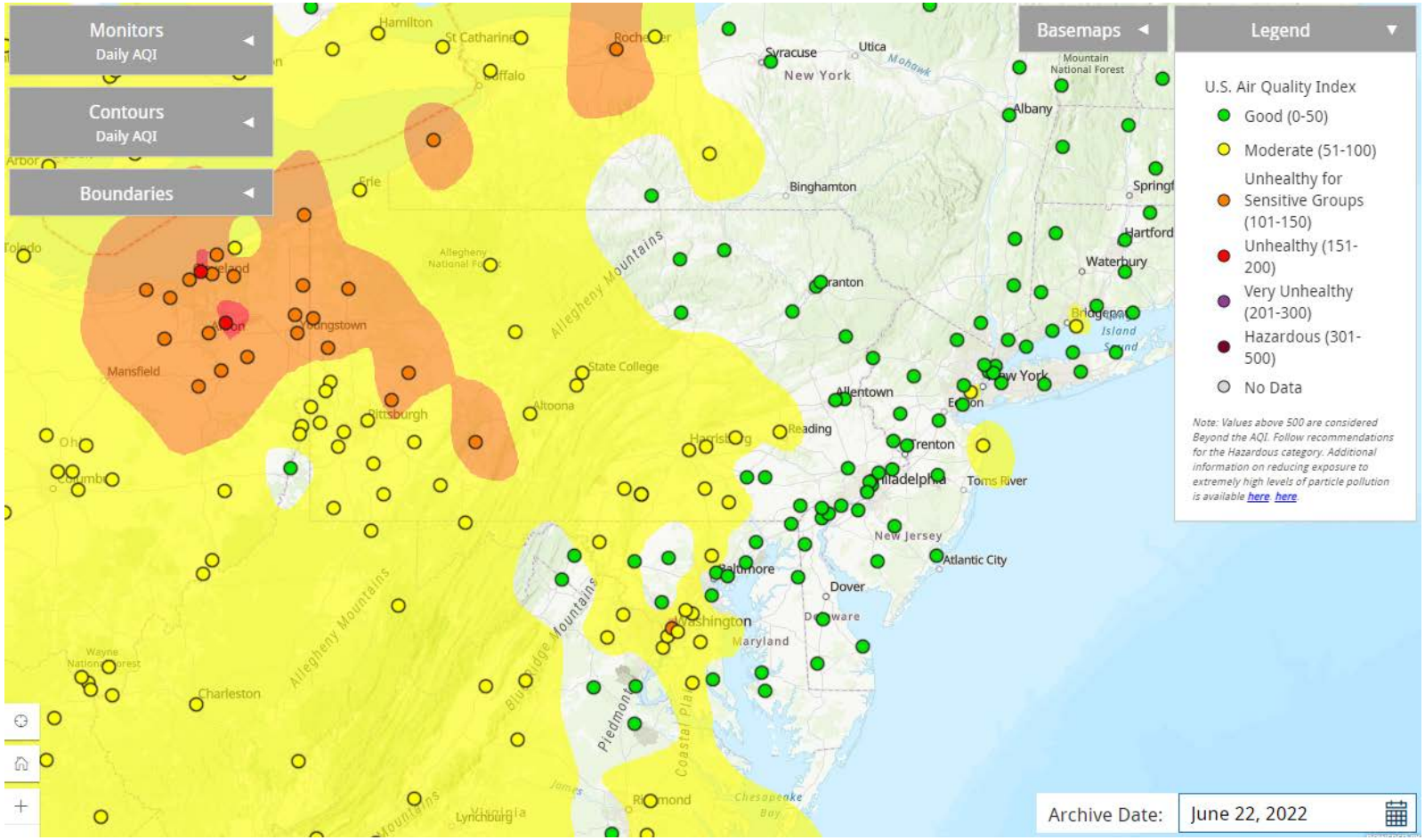


Source: DOEE

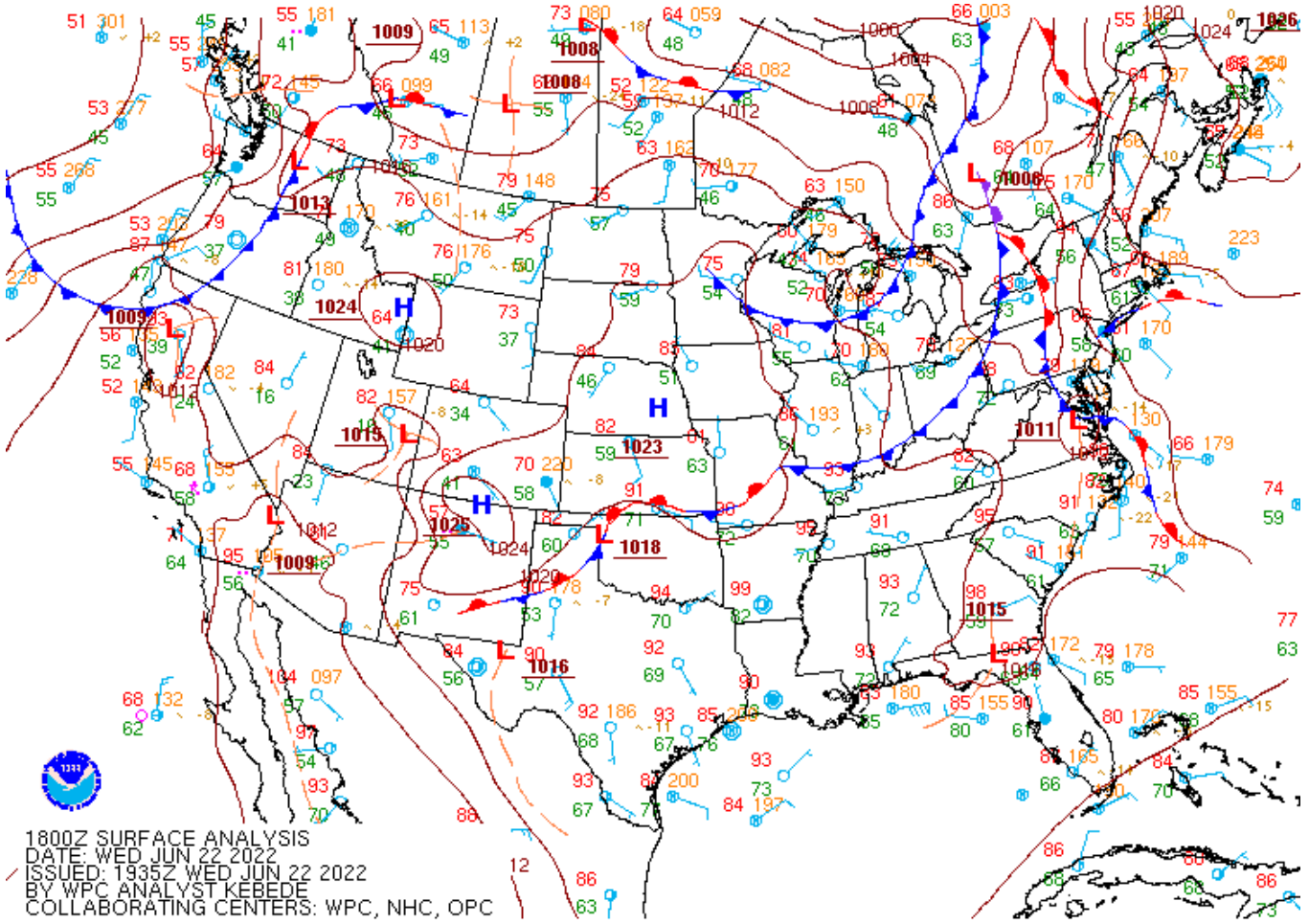
Ozone Levels - 6/21/22



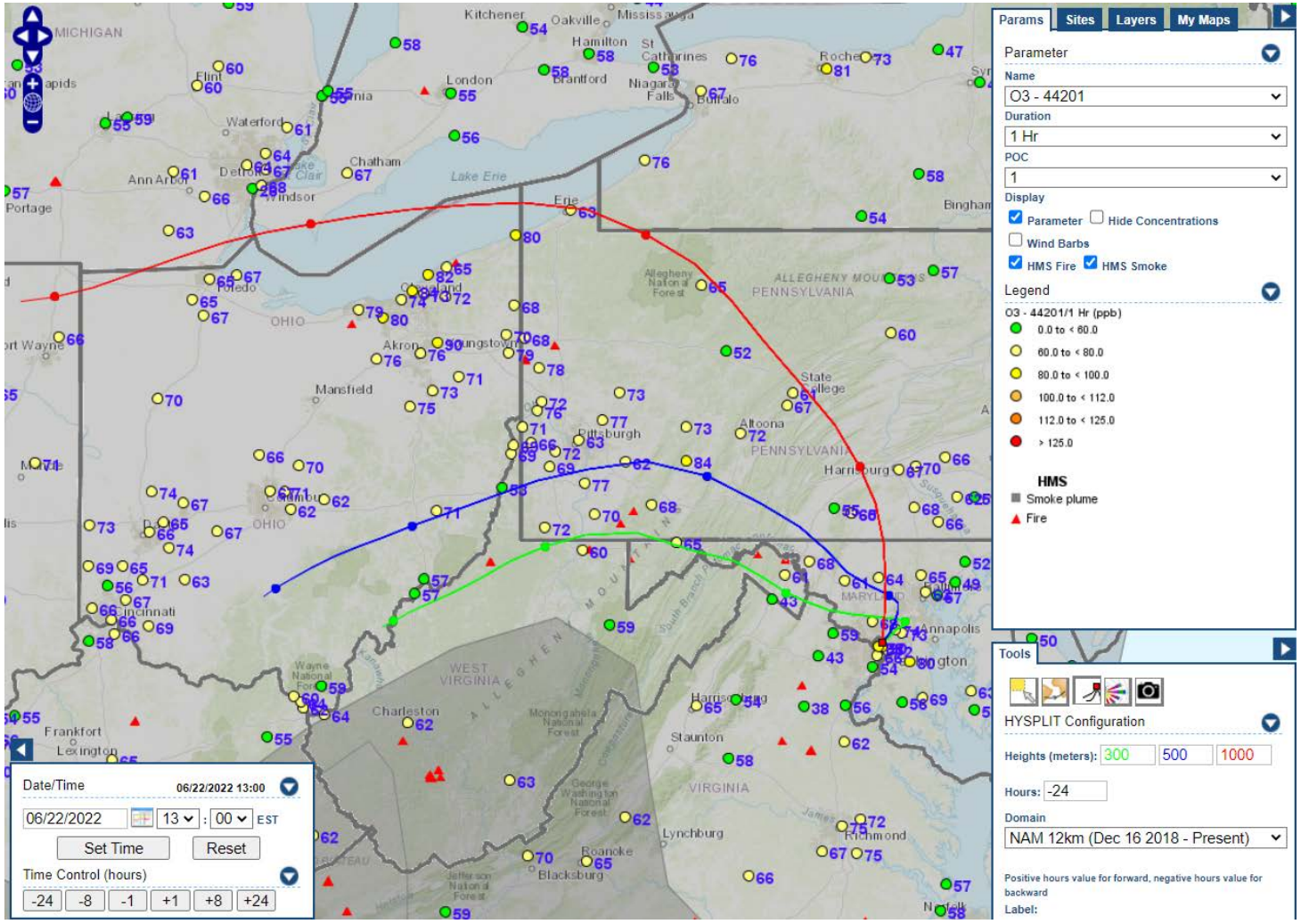
Ozone Levels - 6/22/22



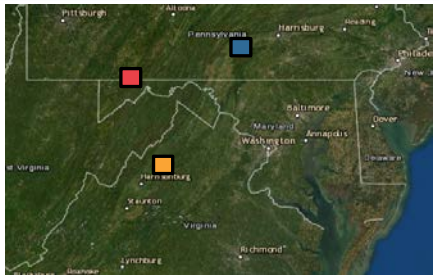
Surface Analysis - June 22

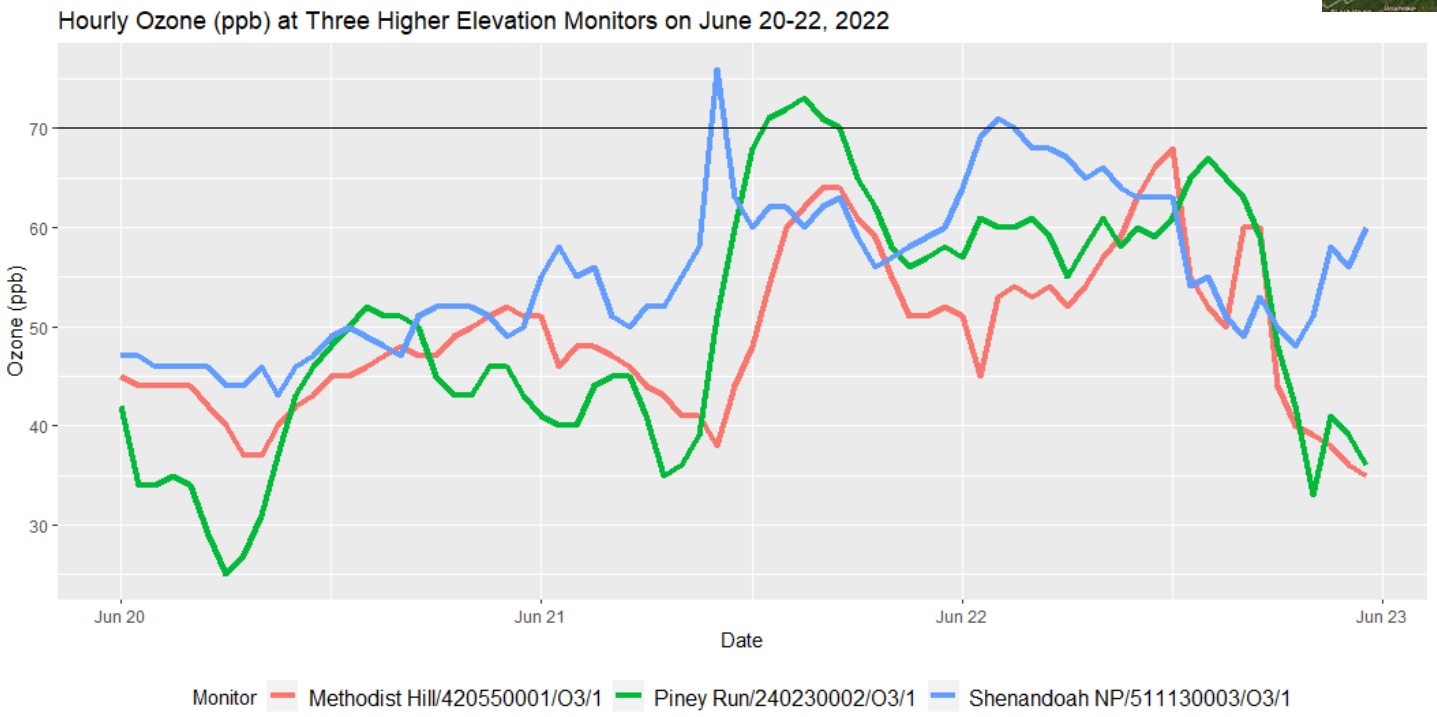


Fire/Smoke - June 22



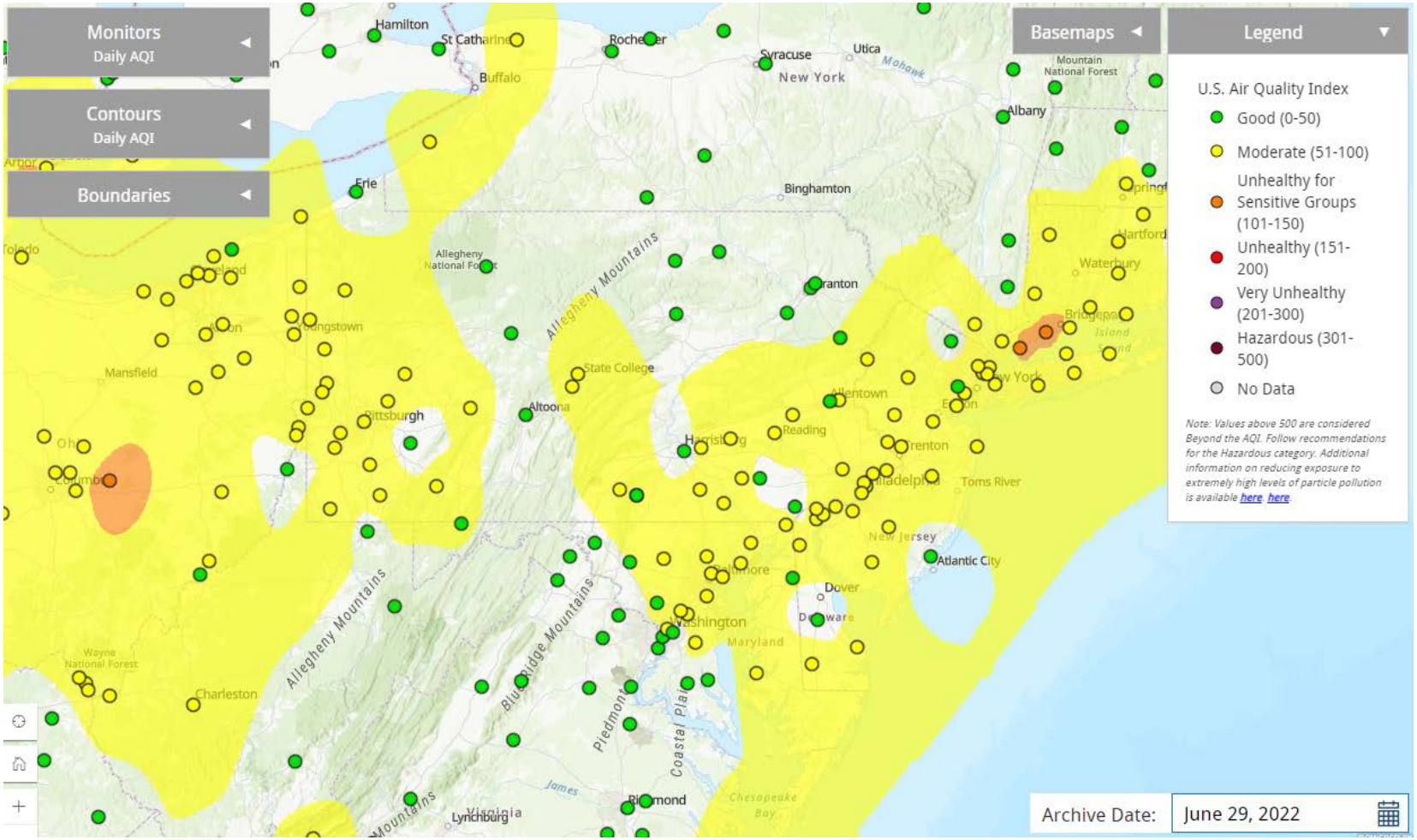
June 22 Transport Signals



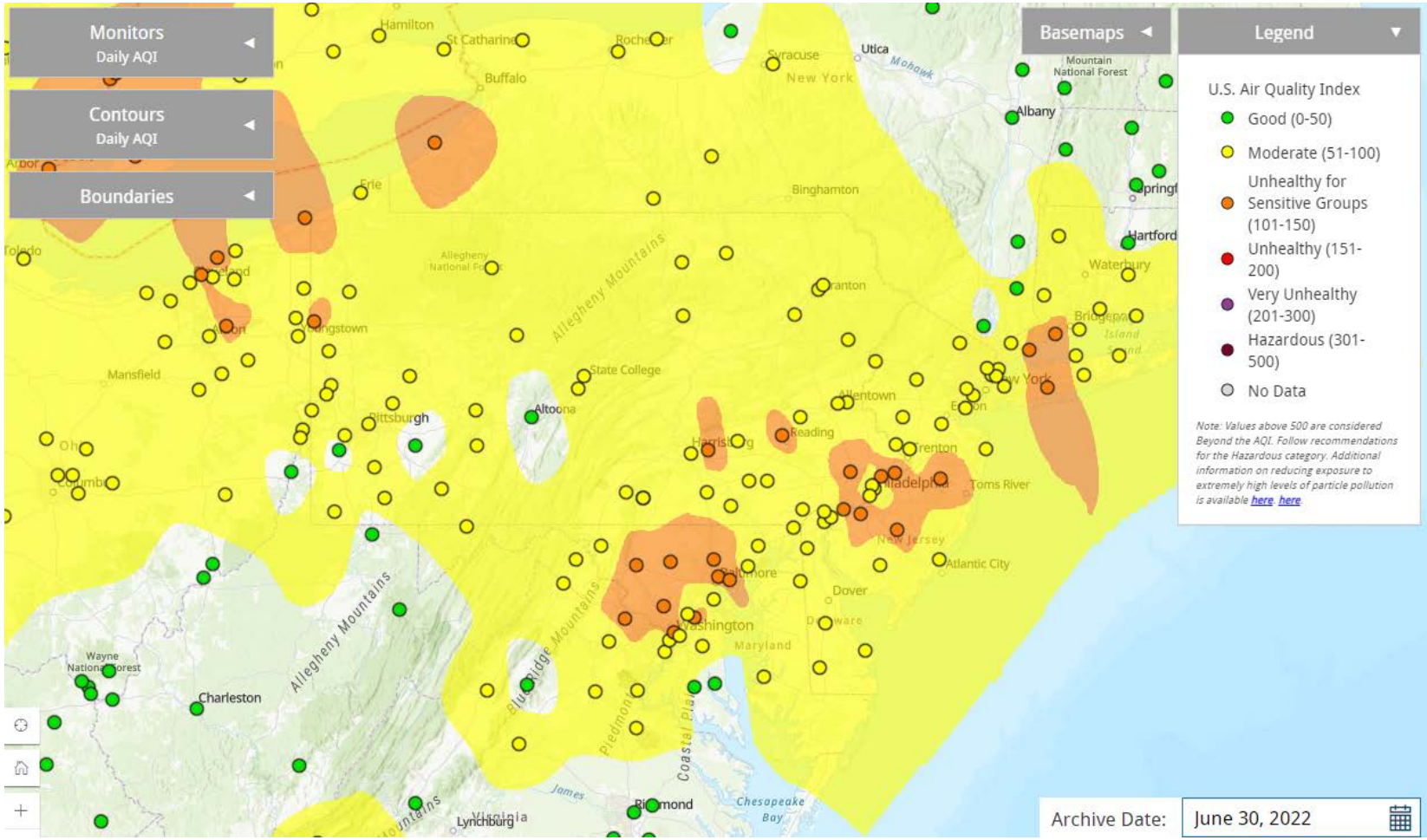


Source: Provided by Howard University to DOEE

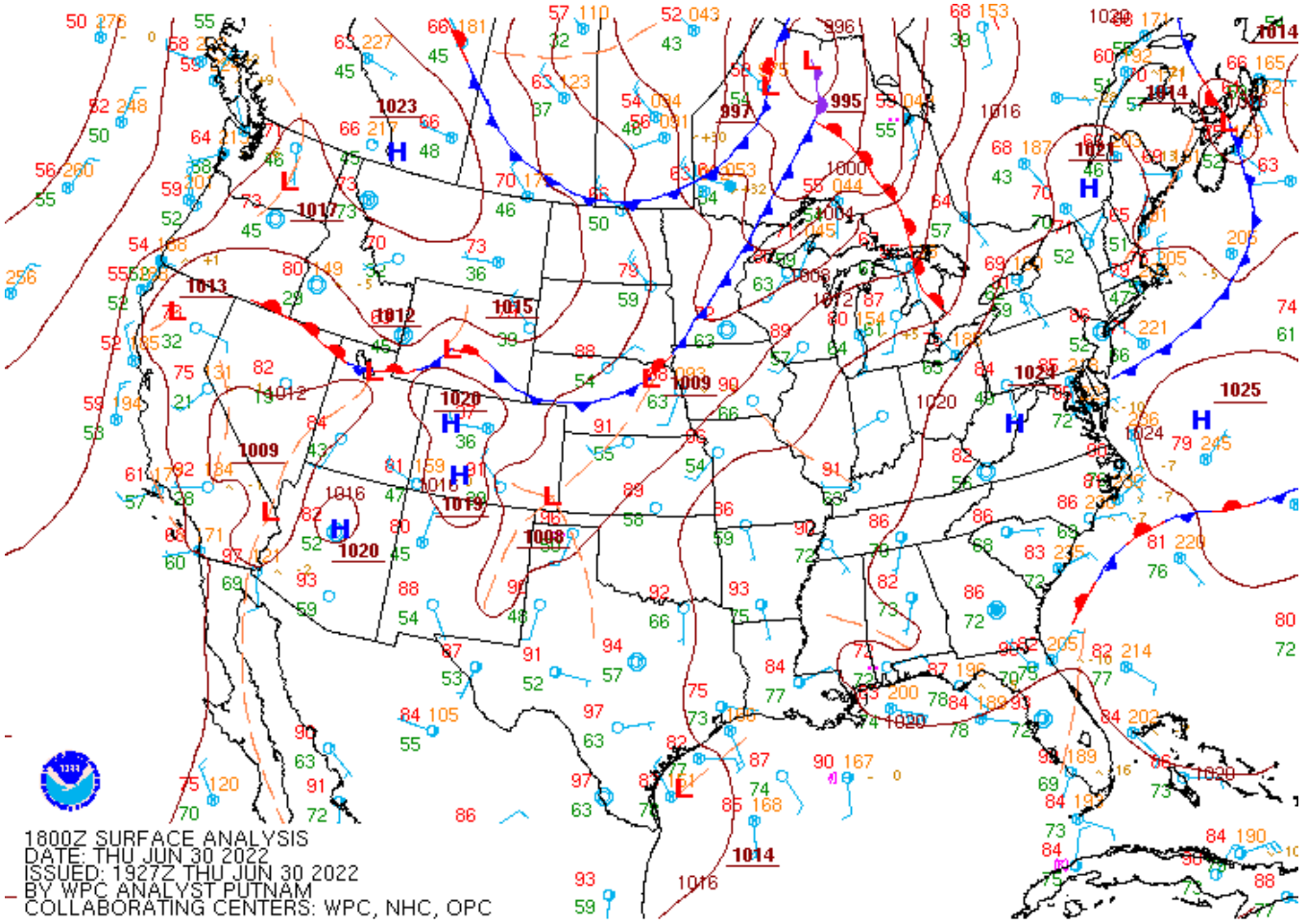
Ozone Levels - 6/29/22



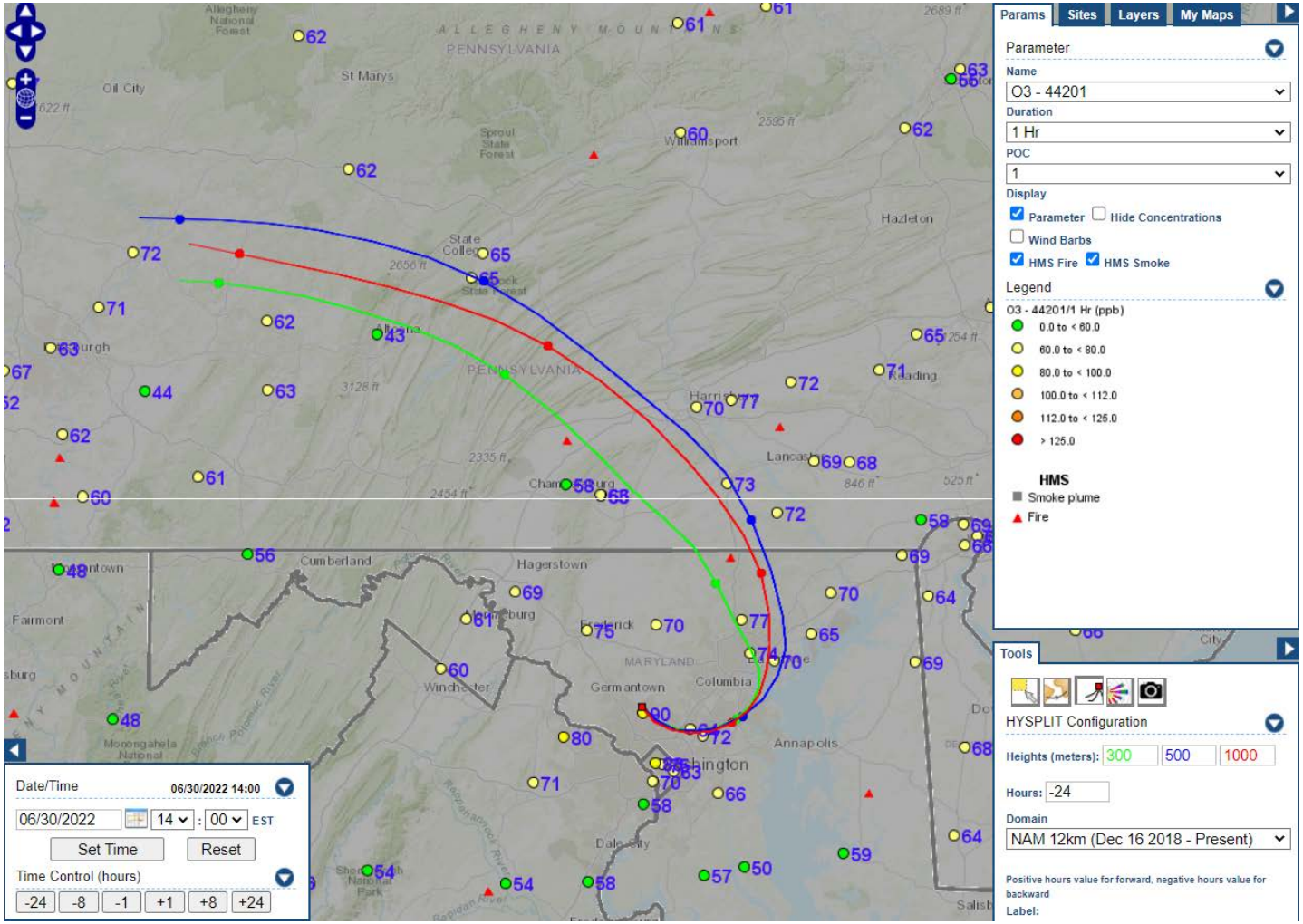
Ozone Levels - 6/30/22



Surface Analysis - June 30



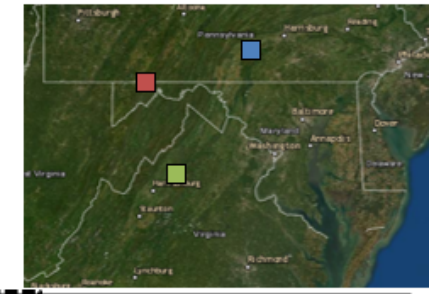
Fire/Smoke - June 30

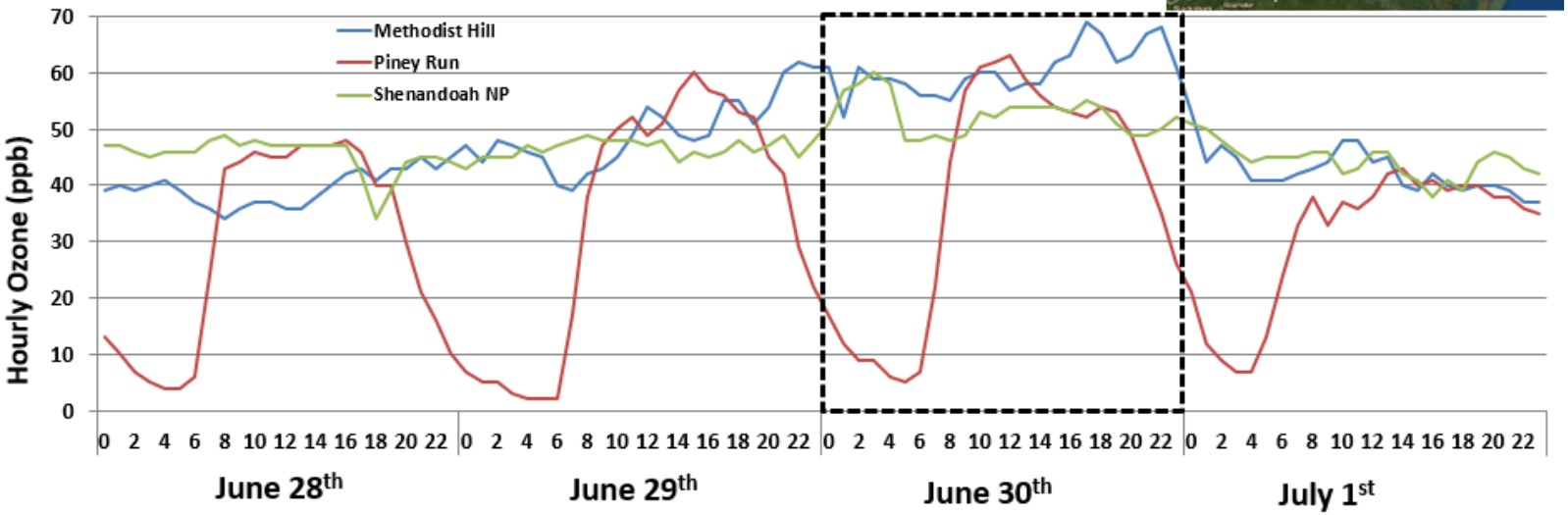


June 30 Transport Signals

Hilltop Monitor Ozone Concentrations

- Increase in ozone across high elevation monitors, peaking on June 30th
- 50-65+ ppb ozone measured

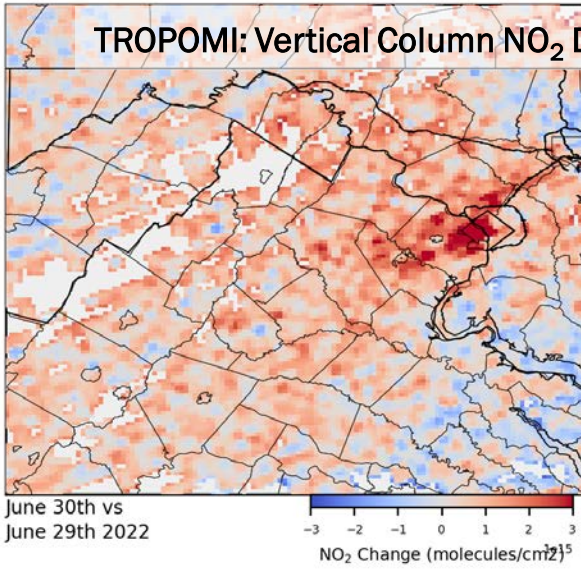


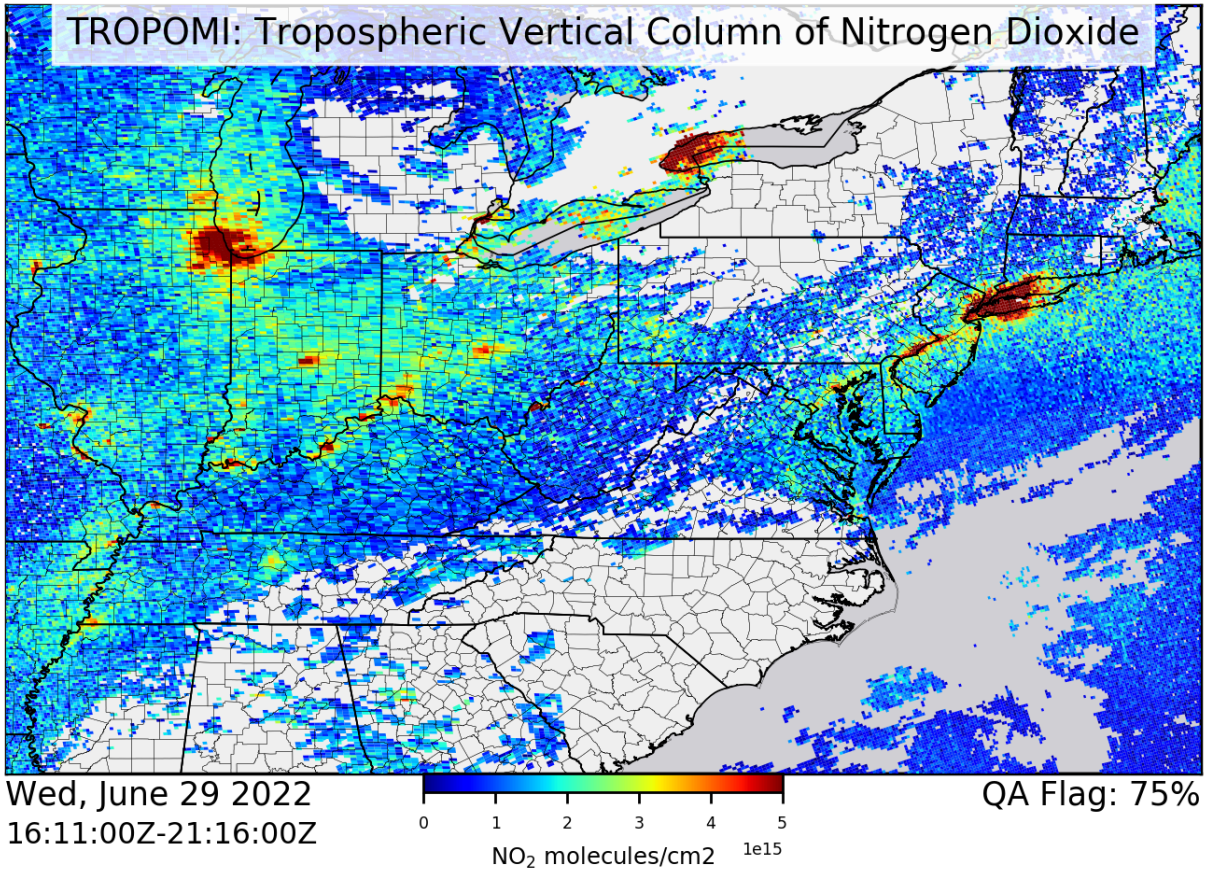


Source: MDE

TROPOMI Vertical Column NO_2: June 30th

- **Tapped into transport**
- **Highest measurements in MD found around BAL/DC and I-95**

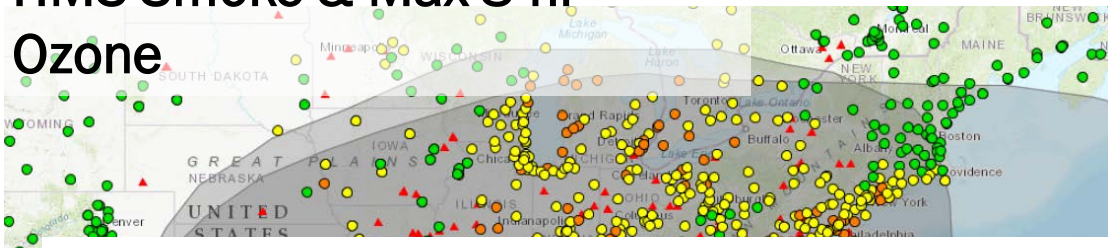




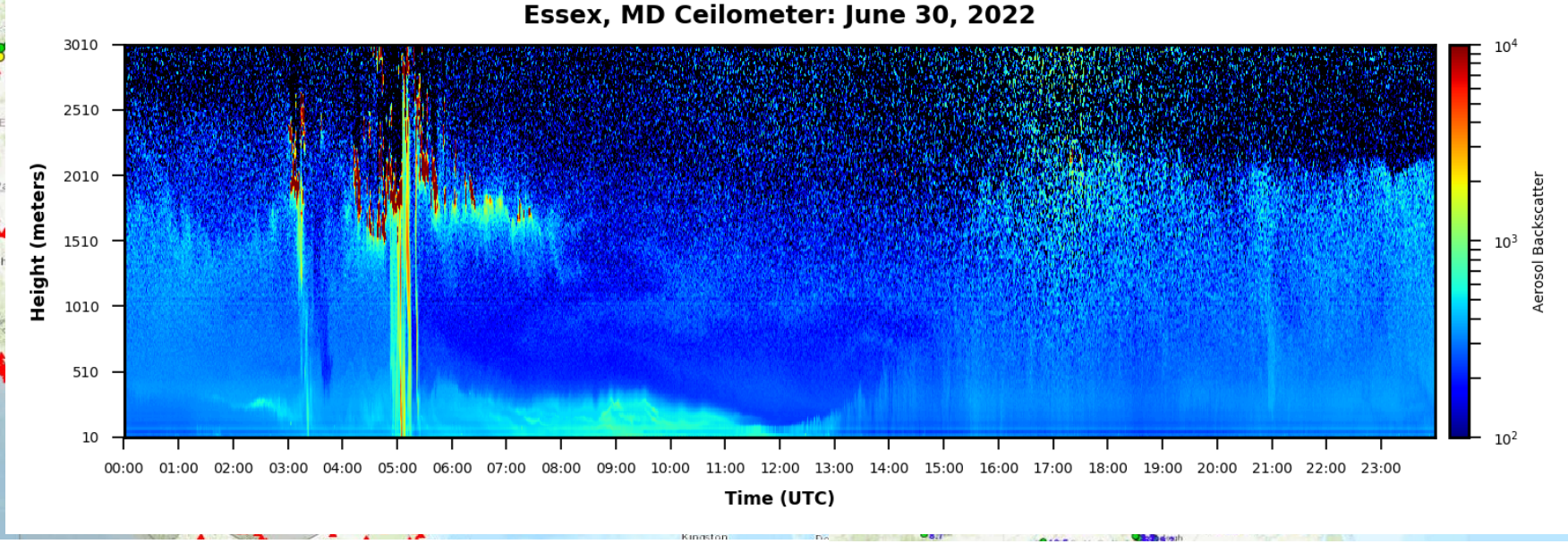
Source: MDE

HMS Fire and Smoke: June 30th

HMS Smoke & Max 8-hr Ozone

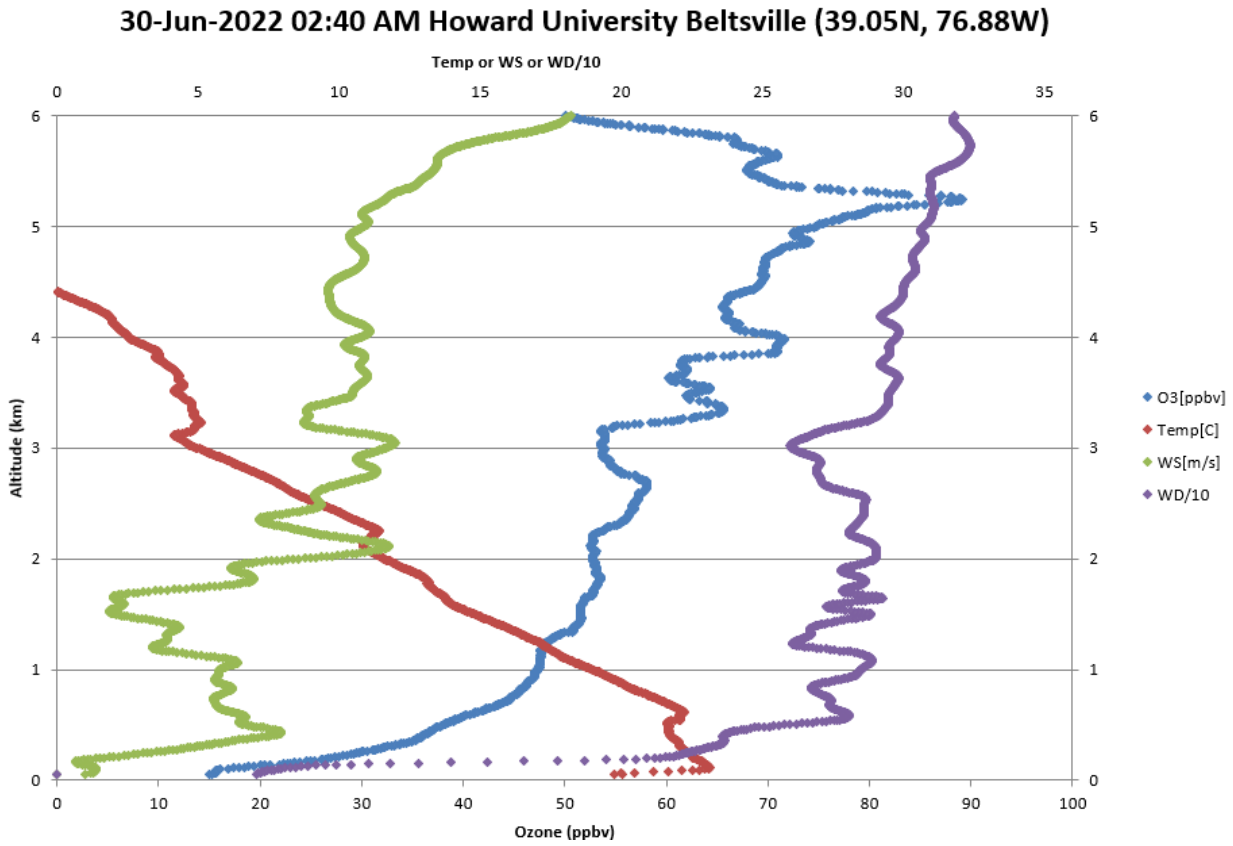


- HMS Smoke matches well with highest ozone concentrations
- $PM_{2.5}$ and other surface trace species not overly impressive



Source: MDE

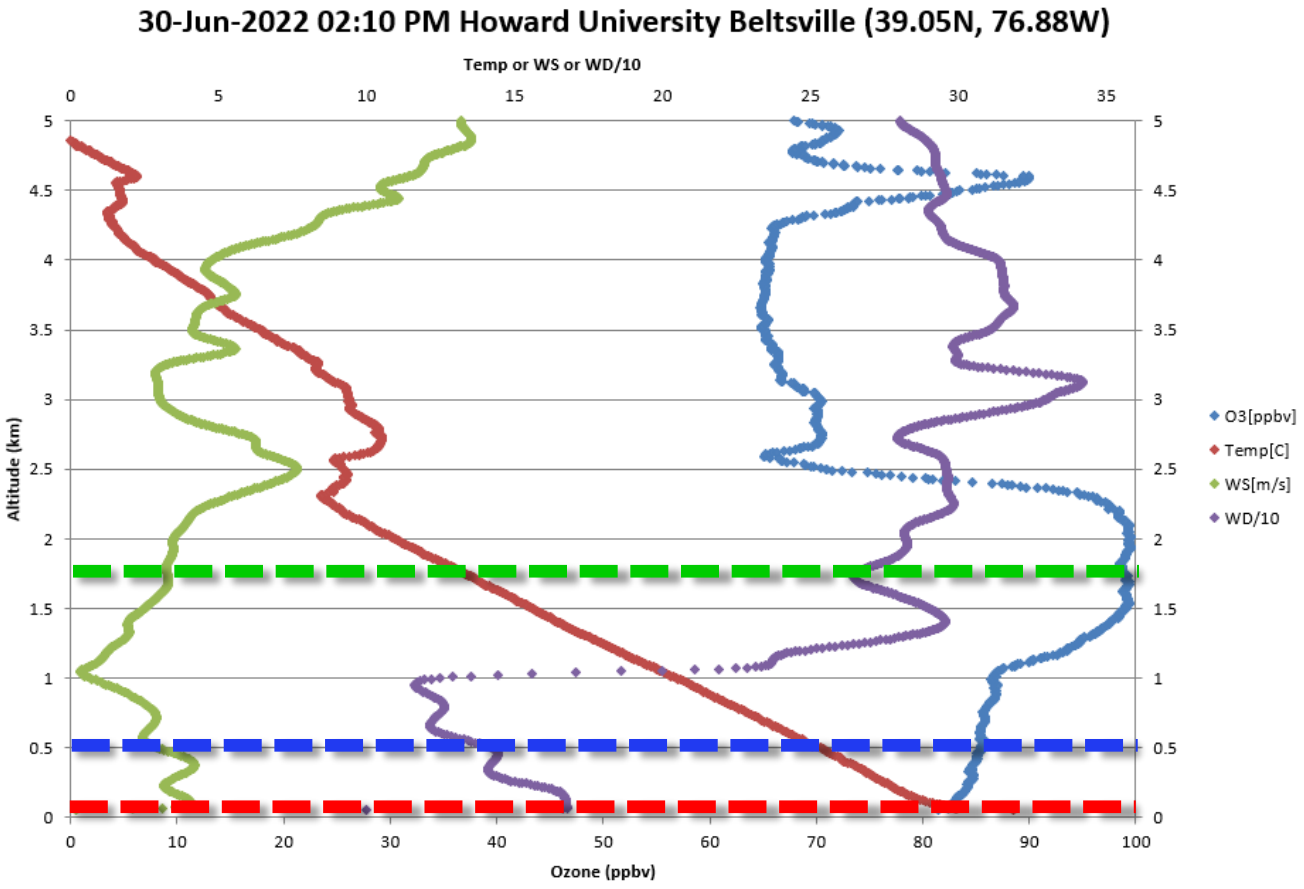
Ozonesonde: Morning June 30th



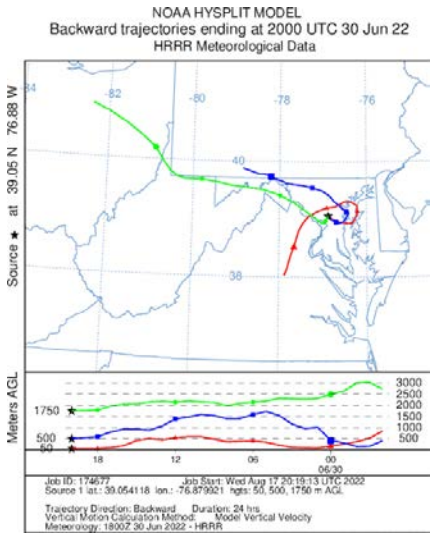
- Westerly/Northwesterly flow above the first 0.5km
- Gradual increase in ozone, peaking at 80+ ppb ~5.5km

Source: MDE

Ozonesonde: Afternoon June 30th

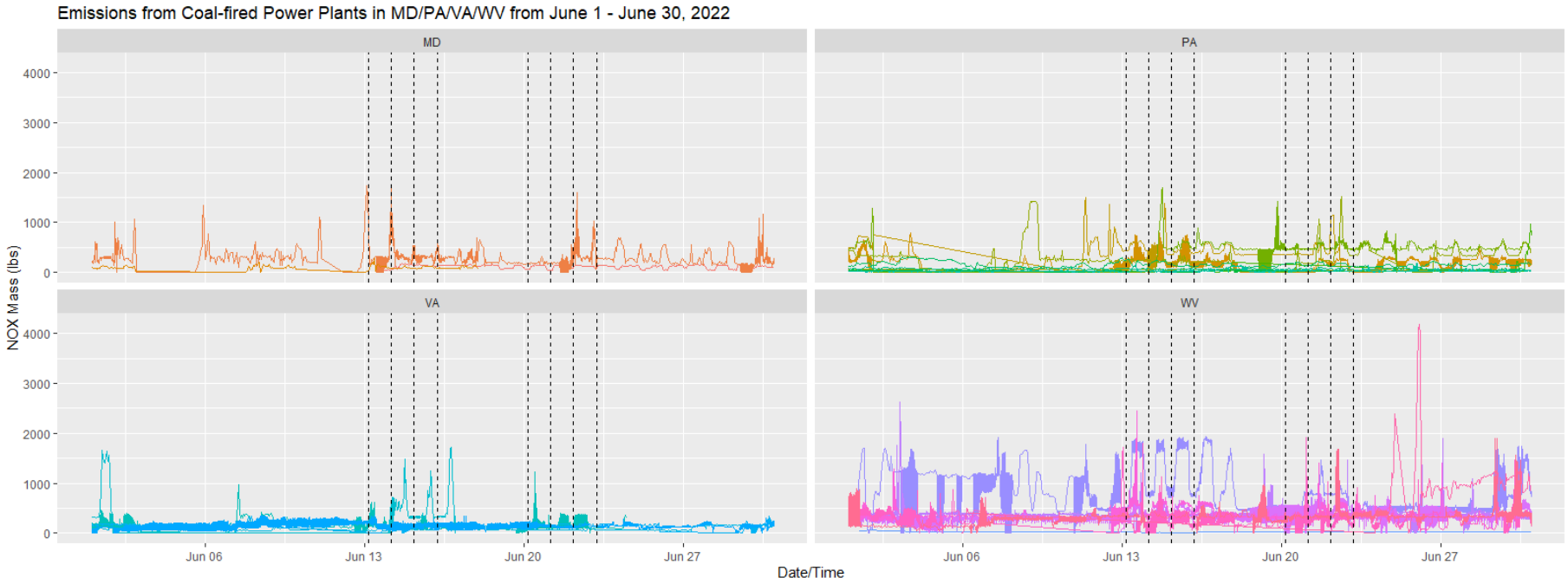


- Slightly "cleaner" air in the lowest 1km as winds shifted SE
- Deep layer of ~100ppb ozone within the PBL



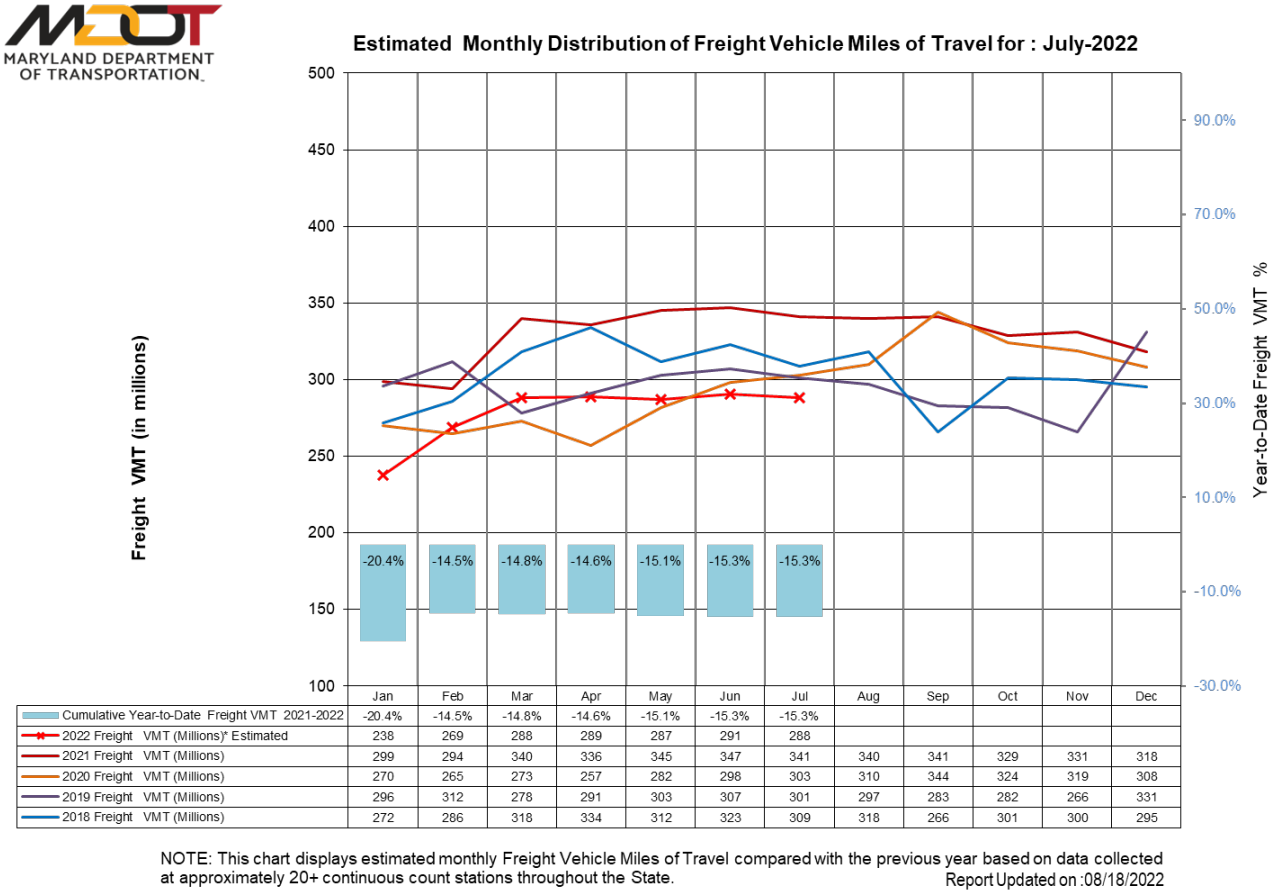
Source: MDE

June 2022 Coal Power Plant Emissions



Source: DOEE

MDOT: Freight Vehicle Miles



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Year-to-Date Freight VMT 2021-2022	-20.4%	-14.5%	-14.8%	-14.6%	-15.1%	-15.3%	-15.3%					
2022 Freight VMT (Millions)* Estimated	238	269	288	289	287	291	288					
2021 Freight VMT (Millions)	299	294	340	336	345	347	341	340	341	329	331	318
2020 Freight VMT (Millions)	270	265	273	257	282	298	303	310	344	324	319	308
2019 Freight VMT (Millions)	296	312	278	291	303	307	301	297	283	282	266	331
2018 Freight VMT (Millions)	272	286	318	334	312	323	309	318	266	301	300	295

NOTE: This chart displays estimated monthly Freight Vehicle Miles of Travel compared with the previous year based on data collected at approximately 20+ continuous count stations throughout the State.

Report Updated on :08/18/2022

- MDOT Report: "Passenger and Freight demand has flattened out this year with increased inflation and rising gasoline prices"

Source: MDE

Conclusions

- Violation of ozone NAAQS not impossible in 2023 after 2020 data is out of picture.
- Despite favorable weather (high temp, low wind) observed on many days, ozone exceedances were very limited in numbers (only 3).
  - Need availability of most of the factors such as, weather, recirculation, local emission, ozone transport, and smoke on any given day for exceedance to occur
- Did low freight VMT indicate economic slowdown leading to low ozone levels this year?
- Role of climate change – Changing weather pattern

Acknowledgements

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